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RECOMMENDED PRACTICES FOR INTERACTIVE VIDEO PORTABILITY

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The recommended practices in this document provide platform independence for Level III interactive video systems. Platform independence permits applications to run without modification on any hardware platform based on a general class of host computers. These recommendations establish a uniform application interface and command set for achieving platform independence. They are intended for system-level, not device-level independence. The recommendations address MS-DOS and PC DOS systems based on Intel 80x86 processor architecture. Other operating systems and architectures will be addressed in the future. Adoption of the current recommendations will benefit the interactive video community by furnishing a common ground for manufacturers, system integrators, courseware developers, and end-users in a field of rapidly changing technologies.

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FOREWORD

These standard practices were developed by the Compatibility Committee of the Interactive Video Industry Association with the support and guidance of the Institute for Defense Analyses. They are being distributed for comment to major vendors, developers, and users of interactive video systems, software, and courseware in industry and government. Once this process is complete, these practices will be incorporated in Military Standard 1379D "Military Training Programs," for use by all departments and agencies of the Department of Defense. The version documented here has been reviewed by J. D. Fletcher for the Institute for Defense Analyses, by the Interactive Video Industry Association Board of Directors, and by senior technical staff of the following companies: Baker Videoactive, Online Computer Systems, Sony Corporation of America, and WICAT Systems.

This work was sponsored by the Office of the Assistant Secretary of Defense for Force Management and Personnel under the technical monitorship of Gary Boycan and by the American Forces Information Service, Office of the Assistant Secretary of Defense for Public Affairs, under the technical monitorship of LTC G. A. Redding, USA.

ABSTRACT

The recommended practices in this document provide platform independence for Level III interactive video systems. Platform independence permits applications to run without modification on any hardware platform based on a general class of host computers. These recommendations establish a uniform application interface and command set for achieving platform independence. They are intended for system-level, not device-level independence. The recommendations address MS-DOS and PC DOS systems based on Intel 80x86 processor architecture. Other operating systems and architectures will be addressed in the future. Adoption of the current recommendations will benefit the interactive video community by furnishing a common ground for manufacturers, system integrators, courseware developers, and end-users in a field of rapidly changing technologies.

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1 Introduction

This document presents recommendations for commands and interface mechanisms used in level-III interactive video (IV) systems. The recommendations are based on functional definitions that were developed with input from IV manufacturers, developers and users. The foundation for these definitions includes an extensive set of models that were developed for internal use to ensure an approach that addresses current needs and capabilities while providing for future growth in IV technology.

This is a working document. As such, it serves two major purposes. First, manufacturers and developers can start working to implement the recommendations now instead of waiting for the completion of the formal ratification process. Second, industry members and end-users can contribute to the final recommendations by submitting comments.

1.1 Scope of the recommended practices

The recommended practices in this document provide platform independence but not device interoperability (plug-and-play).[1] Platform independence lets applications run without modification on any hardware platform based on the same general class of host computers. It requires consistent behavior from different hardware platforms at the application-interface level.

Furnishing such consistency is the immediate goal of the software definitions in this working document. This goal is not trivial. We anticipate changes in this document as specific needs are uncovered during the implementation of the recommendations. However, we anticipate that these changes will be uncovered early in the implementation process and will not be extensive enough to significantly impact implementations based on this document.

1. Device interoperability requires classes of related devices to furnish functionally identical services at the component level. This document does not address device interoperability.

The current recommendations address MS–DOS and PC DOS systems based on Intel 80x86 processor architecture. Other operating systems and architectures will be addressed in the future.

1.2 Goals and benefits

IV technology fulfills many types of training and educational requirements, yet platform-specific courseware has severely restricted its use. Many applications require proprietary software, special hardware, or both. We recognize the critical need for compatibility in IV technology to promote IV usage; lower costs for integrators, developers, and users; and encourage integration in a competitive market.

The specific goal of the current recommendations is to establish a uniform application interface and command set that supports unmodified IV application programs on different delivery systems. We **do not** endorse specific IV hardware systems or mandate the use of products from specific suppliers. Instead, our ultimate mission is to end such requirements.

Adoption of the current recommendations will benefit the IV industry by furnishing a common ground for manufacturers, systems integrators, courseware developers, and end-users in a field of rapidly changing technologies. The recommendations will furnish many benefits including:

- Broader acceptance of IV technology and subsequent growth of the marketplace.
- Assurance of long-lasting investments in IV applications and systems.
- Reduced need to change and support IV applications for specific hardware configurations.
- Increased productivity, lower maintenance costs, and improved application consistency across platforms.
- Higher quality and less costly IV applications resulting from a larger marketplace and the application of resources to software development instead of customizing software and platforms.
- Greater compatibility between international IV communities.

1.3 Document organization and intended audience

The information in this document is intended for IV manufacturers, systems integrators, authoring system developers, and software developers who wish to comply with the recommended practices. This document includes nine major sections and four appendices.

- Section 1, this section, includes background information, the scope of the recommendations, the benefits of adopting them, document conventions, and comment procedures.
- Section 2 includes an overview of the software architecture, the hardware and operating system assumptions, a summary of the IV service groups addressed by the command set, and an explanation of required and optional commands and parameters.
- Section 3 introduces the binary and ASCII application interfaces, explains the parameters and associated values used by the interfaces, and explains how to use the interfaces.
- Section 4 covers implementation issues including software installation, operating system issues, and ASCII and binary interface issues. It includes detailed information on command and parameter value formats, buffer behavior, device driver modes, and binary interface interrupt settings.
- Section 5 includes summary tables for the command set and its parameters including lists of available commands and parameters including their token numbers.
- Sections 6 through 9 contain detailed command descriptions for the system, visual-management, videodisc, and XY-input device service groups, respectively.
- Appendix A gives detailed recommendations on graphics registration relative to background video.
- Appendix B summarizes accepted graphics modes.
- Appendix C includes brief programming examples in BASIC and C.
- Appendix D covers error handling and lists error numbers with messages and explanations.

Note: Those who are interested primarily in the command set should read Section 1.4 and all of Section 3 for background information before proceeding to the command sections.

1.4 Document conventions

Familiarity with the conventions used in this document will aid understanding. These conventions are discussed below.

Figures and tables are referenced in the text by number. Each number consists of the major section number followed by a sequential figure or table number starting with one for each major section. For example, Table 2–3 refers to the third table in Section 2. Typically, figures and tables immediately follow the first paragraph in which they are referenced.

The term "MS–DOS" is used in a generic sense for Microsoft MS–DOS versions 2.0 and higher and compatible operating systems such as IBM PC DOS versions 2.0 and higher.

Numbers are given either in hexadecimal, binary, or decimal format. Hexadecimal numbers have an "H" suffix, for example 006FH. Similarly, binary numbers have a "B" suffix, for example 0001011B. Decimal numbers are written without a suffix.

Command names and parameters in the text are in bold face. In the example **vdPlay from=1000**, **vdPlay** is a command and **from** is a parameter. Command names use mixed lower and upper case for clarity, while parameters use lower case only. However, case is not significant.

Examples of ASCII interface commands include calling strings and return strings. In the examples semicolons separate commands from explanatory comments. This is strictly a convention of convenience and **does not** imply that the semicolon is a syntactic comment delimiter.

Examples of binary interface commands include microprocessor register contents when the interface is called and after it returns control to the application. Again, semicolons separate commands from explanatory comments.

The binary examples use memory addresses based on the Intel 80x86 microprocessor ES and DI registers. These registers are used for the addresses of parameter packets that contain one or more structures each consisting of a parameter token number and its associated value. The addresses of individual parameters and values within parameter packets are given as hexadecimal offsets in bytes from the base address in ES:DI. For example, ES:DI[10] is the area of memory 10H (16 decimal) bytes after the memory location pointed to by the combined segment and offset address in ES:DI.

1.5 Comment submission

To succeed, we need broad industry support and invite detailed commentary from IV developers, manufacturers, and users. Please describe questions and concerns fully and include alternate suggestions and options. In general, we cannot consider blanket criticisms that do not specify the natures of concerns or suggest alternatives. For example, we cannot consider "I don't like this command" with no other commentary for future revisions.

Steps to follow:

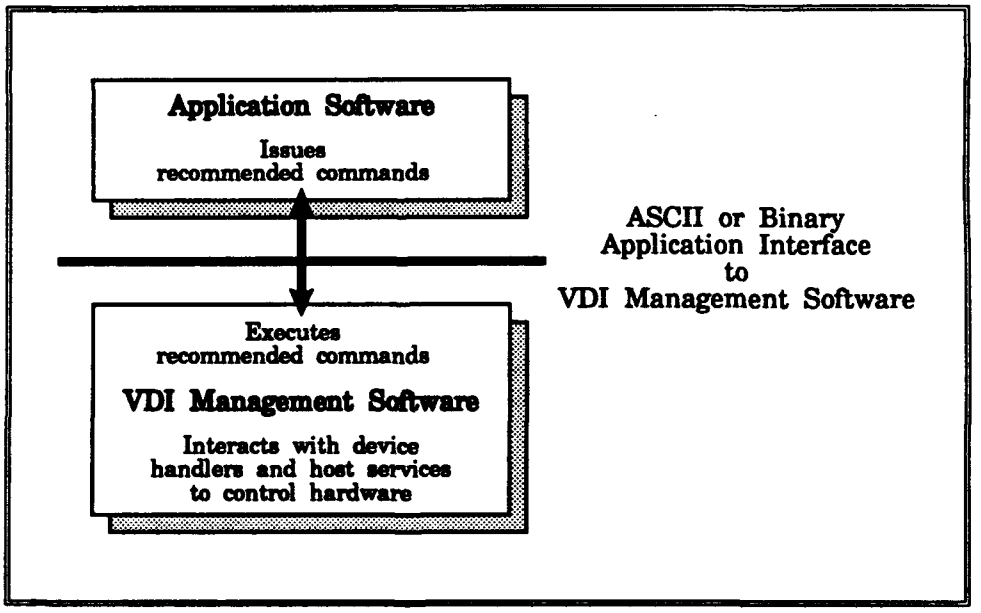
1. Designate qualified technical representatives within your organization who can ably review the various major sections of the document.
2. Ask your technical representatives to:
   a. Respond to the recommendations on an item-by-item basis for your organization.
   b. Furnish a list of questions, comments, and suggestions, referencing the commands by name.
   c. Furnish a list of questions, comments, and suggestions for other sections of the documents referencing document number, section number, page number, and paragraph.
3. Comments **must** be submitted in writing and should include your mailing address, telephone number, and, if available, fax number.
4. To ensure that your comments are considered and that your organization receives further information and documents, address all correspondence to the address or fax number given in the accompanying cover letter. (If the cover letter is not available, contact the publisher given on the copyright page.)
5. Along with your comments please state specific areas of interest.

It may be useful to identify several technical representatives with different interests and backgrounds, and to have each individual or group review sections in their areas of expertise. This may make in-depth responses easier than having several individuals review the entire document.

2 System overview

Figure 2–1 shows the general software architecture of a compliant system. The recommended practices are based on sets of high-level commands organized functionally by service group. These commands are issued by an application and passed via an ASCII or binary application interface to the Virtual Device Interface (VDI) Management Software.[1] VDI Management, in turn, executes the commands by calling appropriate low-level services and passes responses back to the application via the application interface. VDI Management is responsible for making different delivery platforms functionally compatible at the application interface level, thus enabling the implementation of platform independent commands.

Figure 2–1. The general software architecture of a compliant system



1. In the context of this document, the term "application" includes authoring software that may have been used to develop the application.

2.1 Hardware and operating system assumptions

The recommended practices make several assumptions about the computer, its operating system, and the IV hardware. These include:

- The computer is based on an Intel 80x86 processor with MS–DOS version 2.0 or higher, PC DOS version 2.0 or higher, or a functionally equivalent operating system.
- The computer uses an IBM PC/AT-compatible ROM BIOS
- The system has a graphics/video overlay capability using CGA, EGA, or VGA graphics, or uses two monitors, one with video and the other with graphics.
- One or more of several XY-input devices may be present (touch screen, mouse, light pen, bit pad, or other).
- One or more videodisc players or functionally equivalent video sources may be present.

Although this document describes interfaces for MS–DOS, we realize the import of other platforms. IV systems based on the Apple II and the Macintosh are widely used, and applications for OS/2 and Microsoft Windows are starting to appear. Procurement policies of the U.S. Government will encourage POSIX applications, and applications exist for UNIX, VMS, and others.

Therefore, we designed the recommended practices with the intent to adapt them to other operating systems and non-80x86 hardware platforms. The general structure and functionality of the commands are transferable to other environments. However, substantial portions of the current recommendations are, of necessity, specific to MS–DOS.

2.2 Interface design criteria

The criteria used in designing the interfaces in the recommended practices include:

1. The recommended practices should not keep application authors from choosing appropriate languages for the tasks at hand. Compatible languages should include, but not necessarily be limited to, general purpose programming languages, computer-based training (CBT) authoring systems, artificial intelligence (AI) tools, prototyping systems, and database managers.
2. Access mechanisms should be as consistent as possible, both for a single operating system and across different operating systems.
3. It should be possible to upgrade the recommended practices as required by technological developments without affecting existing applications.

4. The recommended practices should include both simple, easy-to-use commands for doing simple tasks and sophisticated functions to support the most demanding IV applications.
5. The commands should not depend on any one operating system, though the interfaces must to some extent be specific to individual operating systems.
6. Except for features that affect the application interfaces, the recommended practices should not require a specific VDI Management software architecture.
7. Hardware-specific assumptions should be defined in detail.
8. Memory requirements and performance costs should be kept to a minimum. Therefore, implementation decisions should side with simplicity when possible.

We have used these criteria to define a software platform that should furnish a high degree of portability for a variety of IV applications while keeping implementation costs and run-time resource requirements to a minimum.

2.3 The rationale for two interfaces

The goal of supporting a variety of programming languages led us to propose that for MS–DOS one interface should include an installable device driver capable of standard, ASCII communications. Some programming systems, including several popular interpreters, have primitive facilities for interfacing with other software. However, almost all programming systems can access files and, therefore, use device drivers.

More sophisticated programming systems that can issue software interrupts should have a more efficient interface available. This is the binary interface that accesses VDI Management through a software interrupt.

In the current recommended practices the command list is the same for both interfaces, but additional parameters are available to binary interface programmers. For example, the binary interface can pass an entire palette as a pointer to an array of individual palette colors. This is difficult to express with ASCII strings and, therefore, not supported by the ASCII interface.

However, each command name in the ASCII interface has a binary interface token number that furnishes either the same functionality or a superset thereof. Each ASCII parameter name has a corresponding binary parameter token number. The high degree of consistency between the two interfaces should simplify their implementation and use.

In future versions, we would not rule out commands that are available from the binary interface only. However, the facilities furnished by the ASCII interface will remain a strict subset of those available from the binary interface.

2.4 Service groups and command organization

Commands that map to related services are separated into service groups. Systems suppliers and applications developers can use only those service groups that include functions required for a given application. This organization also supports adding new service groups in a modular fashion as new capabilities become generally available. Examples of service groups that may be considered for future addition include: windowing environments and graphical user interfaces, audio management, digital audio, and digital video.

Currently, the recommended practices include four service groups: general system (sy), visual management (vm), videodisc (vd), and XY-input device (xy). The sy service group does system-level hardware and software initialization, furnishes information about the availability of other service groups, implements a command queue, and has commands to help with error handling. The other groups address the functional areas for which they are named. However, the groupings are for convenience of organization and do not necessarily dictate which hardware must actually perform the commands.

> The general system group (sy) is the only group that must be included in all compliant implementations.

System suppliers are responsible for ensuring correct installation of system hardware and software and for making a list of installed service groups available to the application through the system commands. System suppliers also must include a way for users to assign contiguous, logical numbers starting with zero to specific devices within a service group when more than one such device is present. Note that this lets users specify the order of devices within each class, but does not let users assign arbitrary numbers to the devices. (Section 4 covers these issues in detail.)

2.5 Core and extended commands and parameters

The command set includes both core and extended commands. Individual commands, in turn, may include both core and extended parameters.

Core commands in a given service group furnish the general functionality required by IV applications. If a given service group is implemented, all core commands for the group **must** be included for the implementation to be compliant. Similarly, if a command is implemented, all core parameters for the command **must** be included.

Extended commands and parameters are nonportable. They are provided for developers who need to produce both portable courseware and applications that need special, nonportable capabilities, or who want to take advantage of

these capabilities if present and properly handle their absence. Extended commands and parameters are not required for compliancy. However, an extended command may include core parameters so that the command's inclusion is optional, but, if it is included, the inclusion of the core parameters is mandatory.

Because manufacturers must support core commands and parameters as a prerequisite to supporting extended commands and parameters, developers can write both portable and nonportable applications using the same tools, authoring systems, and custom libraries.

Note: Some extended commands and parameters may be under consideration for future inclusion in the core command set. However, we do not guarantee that they will be included. An application that **relies** on these commands and parameters is noncompliant. However, an application that uses extended commands or parameters when present and still executes properly in their absence is compliant.

3 Using the interfaces

The recommended practices include two interfaces for MS–DOS, the binary interface and the ASCII interface. By providing two interfaces, the recommended practices can be used with a variety of programming languages. Languages that can issue interrupts will typically use the binary interface for speed and efficiency. Languages without this capability can use standard file I/O and ASCII strings with the ASCII interface. The basic characteristics of each interface are:

- **The binary interface:** Applications communicate with VDI Management by passing and receiving binary values across a software interrupt.

  The binary interface uses an assignable software interrupt in the range 60H to 66H to request VDI Management software services. An application loads the microprocessor's registers with a command code requesting a specific service and a pointer to a parameter packet containing parameter codes and values.

- **The ASCII interface:** Applications communicate with VDI Management through a device driver using file I/O and ASCII strings.

  The ASCII interface uses an MS–DOS device driver for communications between the application and VDI Management. The application writes command strings to and reads response strings from the device driver. A command string consists of a command name followed by parameters and values.

The rest of this section explains how to use both interfaces. Section 4 gives detailed information on implementing the interfaces.

3.1 An introduction to parameters and values

Both interfaces use labeled parameters and associated values. Parameters may have associated calling values, return values, or both. Every parameter value passed to VDI Management is associated with a parameter identifier. Therefore, only those parameters that are actually required by the command need be specified.

Consider the **vdPlay** command, binary interface token number 3081. **vdPlay** instructs the player to play a video segment. Applications can accompany this command with several optional parameters including **from**, **to**, and **speed**.

A **from** parameter and its associated value causes the player to search to a specified frame before entering play mode. Without the **from**, the play starts with the frame that is current when the application issues the command. A **to** parameter causes the player to play to a specified frame and stop. Without the **to**, the play continues until the application intervenes or the player reaches the edge of the videodisc. With a **speed** parameter, the segment plays at the specified speed. Without a **speed**, the segment plays at the normal speed of either 30 or 25 frames per second depending on the video standard, NTSC or PAL, respectively.

With the ASCII interface each parameter value must be preceded by a parameter name so that a parser can decipher the supplied arguments. However, each parameter name does not necessarily require an associated value. Some parameters used to query the system do not have associated values. A command string is variable in length with its length determined by the number of parameters and values.

With the binary interface the parameter packet is an array of parameter structures. Each structure contains a parameter's numeric identifier and the parameter's value or, for parameters without associated calling values, the space for a return value. The minimum parameter packet size depends on the number of parameters.

Continuing the **vdPlay** example, to use the ASCII interface to play from the current frame to the edge of the disk or until a **vdStill** command is issued requires simply:

```
vdPlay
```

To search to frame 1000, then play to frame 1500 use:

```
vdPlay from=1000, to=1500[1]
```

In the first case above, the binary interface does not pass a parameter packet with **vdPlay**. In the second case, it passes a packet containing four 32-bit memory blocks. The first block contains the 24 decimal, the token number for the **from** parameter. The second block contains 1000, the value of **from**. The third block contains 48, the token number for the **to** parameter, and the fourth contains 1500, the value of **to**.

1. Or *vdPlay from 1000 to 1500*; *vdPlay from, 1000, to, 1500*; or *VDPLAY TO 1500 FROM 1000*. All are equivalent, case and parameter order are not significant, and equals signs and commas are optional.

With both the binary and ASCII interfaces, the order of parameters is insignificant. For example:

```
vdPlay from=1000, to=2000
```

and:

```
vdPlay to=2000, from=1000
```

execute identically.

Note: Because order is insignificant, supplying a parameter more than once in a command string or parameter block is an error. This simplifies designing VDI Management parsers and indirectly establishes the maximum number of parameters that can be passed to either interface in a single call. This maximum is equal to the number of parameters for the single command with the largest number of defined parameters.

3.2 Using the binary interface

This section explains how to use the binary interface under MS–DOS and gives detailed information on parameter packets and processor registers.

3.2.1 General procedure

Applications will typically take the following steps to call VDI Management through the binary interface:

1. Build in application memory a packet containing parameter token numbers and values to pass to VDI Management with the command.
2. Load the token number for the command into the AX register.
3. Load the number of parameters contained in the packet into the BX register.
4. Load the segment and offset address of the parameter packet into the ES:DI register pair. (The segment address goes in ES and the offset relative to that segment goes in DI.)
5. Issue the appropriate software interrupt.
6. On return from the software interrupt, check the value of AX. If AX is nonzero, it contains an error code (see Section D), and the application should take appropriate action to recover.

The software interrupt used depends on the contents of the environment space. (See Section 4.4.1 for details.)

3.2.2 Confirming that the binary interface exists

Calling the binary interface through its interrupt vector could have dire results if the interface is not installed. Therefore, applications that use this interface need a way to confirm its existence without calling it with a command such as **syInit**. To this end, the binary interface includes a 16-byte signature of the form:

IVVERnnn...

where "nnn..." is restricted to ASCII decimal digits (ASCII 30H–39H), the decimal point (ASCII 2EH), and terminal NUL (ASCII 00H) characters to pad to 16 bytes if necessary. This is the official version number for the recommended practices implemented by VDI Management as it would be returned by the command **syGetState ivver** (see Section 6). The version number for the current recommendations is "1.0", which yields a signature of:

IVVER1.0

followed by eight NULL characters.

This signature resides at the address pointed to by the IVINT interrupt vector minus 10H. (See Section 4.4.1 for more information on IVINT.)

Note: To confirm that the binary interface is installed, an application must determine the address pointed to by IVINT, then retrieve the information stored in the 16-byte paragraph immediately preceding that address. (We assume that languages that use the binary interface have this capability.)

3.2.3 Parameter packets

A parameter packet contains 8 bytes of memory for each parameter. The 8-bytes are divided into two 32-bit blocks. The first 32-bits contain the parameter token number; the second 32-bits contain the parameter value. (Section 4.4.2 gives detailed information on parameter value formats.)

Parameter token numbers are constants, as defined in Section 5.2. VDI Management uses them to determine which parameters the application is passing. Parameter values may take different types depending on the information being passed. Valid types include signed and unsigned 32-bit integers, pointers consisting of a 16-bit segment and a 16-bit offset, and signed 32-bit fractional numbers.

For example, assume an application has initialized VDI Management and displayed video on the monitor, and now decides to play a video segment starting at frame 1000 and ending at frame 2000. The application sets up the registers and parameter packet as follows:

```
AX  3081        ; token number of vdPlay command
BX  2           ; packet contains two parameters
```

ES:DI is a pointer to a packet containing:

```
Block 1    24      ; token number of from parameter
Block 2    1000    ; value of from parameter
Block 3    48      ; token number of to parameter
Block 4    2000    ; value of to parameter
```

(**Note:** All values in the above example use decimal notation.)

The length of the parameter packet varies with the number of parameters. A packet with five parameters is laid out as shown in Table 3–1.[2] Longer packets are possible by simply adding the extra parameters at the end.

Table 3–1. Example parameter block layout.

Address	Contents
ES:DI[0]	Parameter 1 token number
ES:DI[4]	Parameter 1 value
ES:DI[8]	Parameter 2 token number
ES:DI[C]	Parameter 2 value
ES:DI[10]	Parameter 3 token number
ES:DI[14]	Parameter 3 value
ES:DI[18]	Parameter 4 token number
ES:DI[1C]	Parameter 4 value
ES:DI[20]	Parameter 5 token number
ES:DI[24]	Parameter 5 value

To determine how much memory to allocate for a parameter block that can handle any command for the binary interface, multiply the maximum number of parameters that can be passed by any command by the memory required for one parameter. For example, assume that **syBigCommand** has the longest parameter list at 22 parameters. Each parameter uses 4 bytes for its token number and 4 for its value. Therefore, allocate 8 × 22 bytes or a 176-byte block.

Registers other than AX, BX and ES:DI are insignificant and may contain any value. If a command has no parameters, BX is zero and ES:DI are insignificant. On return, all registers are unchanged except AX. AX contains zero if the command was successful, or an error code indicating a problem. When VDI Management rounds values, it changes the values in the parameter packet in application memory to the rounded values. (See the service group command sections for more information on rounding.)

2. Note that addresses of parameter tokens and value within a packet are described as hexadecimal offsets in bytes from the base address in ES:DI. For example, ES:DI[20] is the area of memory 20H (32 decimal) bytes after the location pointed to by ES:DI. Each 32-bit block uses 4 bytes, so this is the fifth block in the packet.

3.2.4 Return values to parameters

The contents of a parameter packet change depending on the nature of the command. Some commands, such as **vdGetState**, return information to the application. When such a command executes, the application passes a parameter packet with sufficient space for the requested information. The space is allocated using the format described in Section 3.2.3.

A parameter/value structure both defines the requested information and furnishes a return location. On entry into VDI Management, the parameter value is insignificant and can be any value. When VDI Management has derived the requested value, either by calculation or by interrogating the hardware, it puts the value into the appropriate parameter value block.

For **vdGetState frame**, the application might pass:

```
AX          3078        ; token number of vdGetState command
BX          1           ; packet contains one parameter
ES:DI[0]    23          ; token number of frame parameter
ES:DI[4]    Can be any value
```

On return, the values might be:

```
AX          0           ; command executed correctly
BX          1           ; packet contains one parameter
ES:DI[0]    23          ; token number of frame parameter
ES:DI[4]    12345       ; frame number 12345 is currently displayed
```

(**Note:** All values in the above example use decimal notation.)

Applications should check AX and assume that if an error has occurred ($AX \neq 0$), any values returned in the packet are meaningless.

Note 1: If the binary interface returns a pointer to a string, the string is in upper case. This is an arbitrary decision to make return strings easier to parse and to make binary and ASCII return strings consistent.

Note 2: VDI Management may round parameters such as play speeds. If so, VDI Management changes the values in the parameter packet to the actual values used after rounding and subsequent queries return actual values instead of requested values.

3.3 Using the ASCII interface

This section explains how to use the ASCII interface under MS–DOS and includes an explanation of command and response strings.

3.3.1 General procedure

To issue commands to VDI Management via the ASCII interface, applications use standard file I/O to communicate with a device driver named IVDEV. Applications will typically take the following steps to call VDI Management through the ASCII interface:

1. Format a command string specifying the required function.
2. Open the device driver for writing.
3. Write the command string to the device driver.
4. Close the device driver.
5. Open the device driver for reading.
6. Read the response string from the device driver.
7. Close the device driver.
8. Parse the response string. If the string is "OK" or contains expected return values, continue processing normally. If the string is "ERROR n..." where "n..." is an error number, take action to recover from the error.

The exact method of communicating with the driver depends on the programming system.

3.3.2 Confirming that the ASCII interface exists

Applications that use the ASCII interface must be able to confirm that the interface and its associated device driver, IVDEV, are properly installed. Simply verifying that IVDEV can be opened is insufficient because some languages may automatically create IVDEV if it does not exist. Therefore, an application should open the file, write an **syInit** command to it (see Section 6), and read the response string.

- If the response string consists of the ASCII characters "OK" followed by CR/LF, **syInit** was successful. The application should continue normally.
- If the response string consists of "ERROR n..." where "n..." is an error number followed by CR/LF, then the ASCII interface is installed, but VDI Management could not be initialized, indicating improper installation or improper use of **syInit**. The application should handle the error, probably by displaying an error message and exiting.
- If the function used to read IVDEV returns a read error or the response string consists of anything other than "OK" or "ERROR n..." either the device driver is not installed or serious problems exist with VDI Manage-

ment. Some languages may automatically create a file named IVDEV if the driver is not installed. The application should politely exit with an error message and, if necessary, delete the bogus file (preferred) or at least tell the user that a bogus IVDEV file may have been created.

Note: If IVDEV is not installed and a file of the same name is automatically created, it will contain the string the application tried to write to the driver. If this happens, and IVDEV is then installed as a device driver, the bogus file cannot be deleted from the command line because MS–DOS will assume it is supposed to delete the device driver, which is illegal. Therefore, the file must be deleted with the device driver unloaded.

3.3.3 Command strings

A command string is a series of printable ASCII characters terminated with a carriage return (CR, ASCII 0DH). The ASCII interface discards line feeds (LF, ASCII 0AH) following the CR. The string starts with a command name, typically followed by a parameter list. (Section 4.3 gives detailed information on formal command string syntax and parameter value data types.)

Assume an application has initialized VDI Management and turned video on. To play a videodisc segment starting at frame 1000 and ending at frame 2000, the application could issue the command string:

```
vdPlay from=1000, to=2000
```

vdPlay is the command name. It corresponds to the token number passed in the AX register with the binary interface. The substrings **from** and **to** are parameter labels used by VDI Management to determine which parameters are being passed. The substrings "1000" and "2000" are parameter values. Each value is associated with the preceding label, so 1000 is the value of **from** and 2000 is the value of **to**.

Because the string ends with CR, VDI Management can determine how many parameters the application is passing by inspection. Unlike the binary interface, the ASCII interface does not require a parameter count.

3.3.4 Response strings

Response string contents from the ASCII interface depend on the nature of the command string. If the command was correct and did not ask for information, the response string is "OK". If the command asked for information, the ASCII interface returns a series of comma-separated parameter values. If an error occurred, the response string consists of "ERROR" followed by a space, followed by the error number as ASCII digits. All response strings end with CR/LF.

For example, consider:

```
vdPlay from=1000, to=2000
```

If this executes correctly, the ASCII interface returns "OK". However, the command:

```
vdPlay from=1000, from=2000
```

generates the response string "ERROR 54" (Parameter used more than once).

If an application issues the command:

```
vmGetState vlevel glevel
```

which asks about graphics and video fade levels, the response might be "255,200". This says that the video level is 255 and the graphics level is 200.

Note: All alpha characters returned by the ASCII interface are upper case. This is an arbitrary decision to make return strings easier to parse and consistent between implementations.

3.4 Mixing ASCII and binary commands

For a VDI Management module to be compliant, it must furnish both the device driver and software interrupt access methods, although both do not have to be installed. If both methods are loaded, VDI Management should behave correctly when an application mixes ASCII and binary commands.

For example, if an application issues **syQueue on** via the binary interface then issues a series of commands to the device driver, the commands issued via the driver should be queued correctly. Similarly, an ASCII command and its binary counterpart should behave identically assuming both commands have the same parameters available.

To conserve memory and enhance performance, applications that use only one interface should clearly state whether the ASCII or binary interface should be installed. Application vendors also should state the amount of memory required by the application after VDI management has been loaded to alert users of any potential memory problems.

4 Implementation details

This section discusses implementation details for VDI Management and the ASCII and binary interfaces. It includes installation issues, operating system requirements and reentrancy issues, ASCII string and parameter value formats, device driver buffer behavior and communications modes, establishing the binary software interrupt number, and binary data types and formats.

4.1 Installation issues

Installation issues include the installation of VDI Management and assigning logical device numbers at the time of installation. The following subsections discuss these issues.

4.1.1 VDI Management installation

Specific methods of installing VDI Management are outside the scope of the recommended practices. VDI developers can use any appropriate method. Two obvious possibilities are terminate-and-stay-resident (TSR) software and software that takes an application name as a command-line parameter and spawns the application.

For applications that use the binary interface only, the device driver need not be loaded. Similarly, for applications that use the ASCII interface only, the binary interface need not be loaded.

Although VDI implementers must supply both interfaces for an implementation to be compliant, both do not have to be installed in the IV system.

4.1.2 Logical device numbers

Some commands accept a logical device number as a parameter. These include videodisc commands, which may be used on systems with multiple videodisc players, and XY-input commands, which may be used on systems with multiple XY-input devices.

Often, applications will need to know the relationship between device numbers and physical devices. For example, if a system includes both NTSC and PAL videodisc players, an NTSC application should ensure that it controls the NTSC player.

When logical device numbers are allocated, VDI Management lets users assign numbers to specific devices using an appropriate setup facility. *Device numbers must be contiguous and start at zero,* but VDI Management does not make any other assumptions about logical-to-physical device mapping.

Providing a set-up facility for users to assign logical device numbers and requiring contiguous device numbers starting with zero are compliance requirements.

Because of the range of available physical devices and the need to furnish ongoing support for existing applications, it is impossible to prescribe a general way for applications to examine or change the device number mapping. If an application asks for the device type and discovers a device that was not invented when the application was written, it cannot possibly use this information while executing. Therefore, *application authors must clearly state any requirements for a particular device number mapping,* so that users can set up VDI Management appropriately.

For example, assume that a system has two XY-input devices, a mouse and a touchscreen. Also assume that the mouse is installed as device zero and the touchscreen as device one. An application that requires the touchscreen to be device zero cannot change the logical numbering at run time. Therefore, the application author must clearly inform the user that the touchscreen must be installed as device zero when the user installs VDI Management.

If an application needs information about the mapping, it must have a mechanism for the user to provide that information. Appropriate techniques include command-line parameters and files in application-specific formats. If necessary, well written applications should use an installation program that asks which logical device number to use for each peripheral. Well documented applications should carefully explain what kinds of physical devices are appropriate for each selection in the installation procedure.

4.2 Operating system issues

Operating system issues include basic operating system requirements and considerations about the lack of reentrancy under MS–DOS. The following subsections discuss these issues.

4.2.1 Operating system requirements

To support the MS–DOS version of the recommended practices, the operating system must be MS–DOS version 2.0 or later or a functionally equivalent operating system. Versions of MS–DOS prior to 2.0 cannot use installable device drivers. Therefore, systems that cannot run MS–DOS 2.0 or later cannot comply with the MS–DOS version of the recommended practices regardless of the attached IV hardware.

Developers may provide VDI Management software that requires a specific version of MS–DOS. We would describe this as either "Compliant only when used with MS–DOS version N.nn" or, more often, "Compliant only when used with MS–DOS version N.nn *or later*." Such software should test the MS–DOS version number and decline to execute if it is not supported. Similarly, application authors may require a specific version of MS–DOS. Therefore, users of IV hardware and courseware should ensure that the versions of MS–DOS, VDI Management, and courseware that they purchase are compatible.

4.2.2 MS–DOS reentrancy limitations

At certain times—specifically when MS–DOS has suspended processing a function request to service an interrupt—programs are not allowed to call MS–DOS. Consider the tick chain. Approximately 18 times per second, the operating system calls all routines on the tick chain. Tick routines that call MS–DOS must check the MS–DOS critical section flag to ensure that they do not call MS–DOS at an inappropriate time.

Typically, high-level programmers need not be concerned about such issues. Unless a program includes interrupt handlers or tick routines, it will not have control when MS–DOS cannot be called. If a programming system links an interrupt automatically, the system's design ensures that conflicts are handled correctly. Also, programmers who simply call MS–DOS or BIOS functions using standard methods will not encounter problems. However, those who use the tick chain or change MS–DOS or BIOS interrupt vectors must deal with the lack of reentrancy.

VDI Management assumes it can call MS–DOS during any call to the binary interface. Therefore, application software must not call the binary interface when it is unsafe to call MS–DOS or when a previous call to VDI Management has been interrupted. If an application installs interrupt handlers, it

must provide mechanisms to ensure that VDI Management is called at appropriate times only.

If VDI Management does any background processing outside of application calls, it must ensure that MS–DOS is called only when it is safe to do so. Also, the device driver, which is loaded within MS–DOS, must not be called at those times when it is unsafe to call MS–DOS or when VDI Management has been interrupted.

VDI Management may need to do some background processing, and the device driver may have to do some work of its own to overcome reentrancy limitations. For example, assume an ASCII command uses the filing system. Within a device driver, the MS–DOS filing system is already executing and may not be reentered. If the device driver or its support routines must call MS–DOS, the request should be queued and issued after the driver has returned. One method for doing this involves hooking interrupt 21H and executing the DOS call immediately after MS–DOS returns from the device driver.

Note: The binary interface cannot be called directly from within the device driver because the interface, in turn, calls VDI Management and VDI Management must be able to call MS–DOS.

4.3 ASCII interface issues

ASCII interface issues include ASCII text string formats, parameter value formats, device driver buffer behavior, device driver communications modes, and using the IOCTL function. The following subsections cover these issues.

4.3.1 ASCII string formats

Command strings are simply tokens separated by delimiters. Return strings consist of comma-separated values. The following subsections discuss command and return strings formats.

Command string tokens

A command string is a series of tokens, separated by delimiters, and ending with a CR. Tokens are strings of one or more printable characters. They include command names, parameter identifiers, and parameter values. Command names and parameter identifiers consist of characters in the ranges "A" to "Z" and "a" to "z". Case is not significant. For example, the command name "vdPlay" could be supplied as "vdplay", "VDPLAY", or even "vDpLaY". Parameter values consist of characters in the ranges "a" to "z", "A" to "Z", and "0" to "9" plus ".", "+", and "-".

Command string delimiters

Delimiters are the characters equals (ASCII 3DH), space (ASCII 20H), tab (ASCII 09H), LF (ASCII 0AH) and comma (ASCII 2CH). Two adjacent delimiters are treated as if they were a single delimiter. Extra delimiters at the start or end of the string are ignored.

Command string length

Command strings can be at most 255 characters including the CR. Redundant delimiters **do not** count towards the 255-character limit.

Multiple commands separated by CRs may be included in a single string and sent to the ASCII interface with single write operation. The 255-character limit applies to each command in the write operation, not to the write operation as a whole.

Response strings

Response strings always end with CR/LF. If a string contains multiple values, each value is separated from the next by one comma with **no** spaces. Response strings contain no delimiters before the first value or between the last value and CR/LF.

4.3.2 ASCII string formal syntax

The formal syntax description for ASCII command and response strings in Table 4–1 uses a notation derived from the Backus Naur Form (BNF). The syntax uses the following rules.

1. Angle brackets (<>) enclose items that are defined by the formal descriptions.
2. Vertical bars (|) separate sets of alternatives—in deriving a valid command string, one of the alternatives should be chosen.
3. Square brackets ([ ]) enclose optional items or sets of items. Their presence or absence does not affect the string's validity.
4. Spaces separate sets of required items that should occur in the given order.
5. The ":=" sign means "consists of." The item on the left of ":=" consists of the definition on the right.
6. The strings "equals", "space", "tab", "line feed", and "comma" are delimiters and stand for the indicated characters.
7. The string "carriage return" is a terminator and stands for the indicated character.
8. Items in quotes (" ") are string literals and stand for themselves.

Table 4–1. Formal BNF syntax for ASCII command and response strings

<command string>	:=	[<delimiter string>] <command name> [<parameter string>] [<delimiter string>] carriage return[1]
<response string>	:=	"OK" carriage return line feed | "ERROR" space <digit string> carriage return line feed | <result string> carriage return line feed
<parameter string>	:=	<parameter> | <parameter> <parameter string>
<parameter>	:=	<delimiter string> <parameter id> [<delimiter string> <parameter value>][1]
<parameter id>	:=	<letter string> [<digit string>][2]
<command name>	:=	<letter string>[2]
<result string>	:=	<parameter value> | <parameter value> comma <result string>
<parameter value>	:=	<letter string> | <number>| <filename>
<delimiter string>	:=	<delimiter> | <delimiter> <delimiter string>[1]
<letter string>	:=	<letter> | <letter> <letter string>
<digit string>	:=	<digit string> | <digit> <digit string>
<file name>	:=	<legal file name string for operating system>
<number>	:=	[<sign>] <digit string> | [<sign>] [<digit string>] "." <digit string>
<delimiter>	:=	equals | space | tab | comma | line feed
<letter>	:=	"A" | "B" | "C" | "D" | "E" | "F" | "G" | "H" | "I" | "J" | "K" | "L" | "M" | "N" | "O" | "P" | "Q" | "R" | "S" | "T" | "U" | "V" | "W" | "X" | "Y" | "Z" | "a" | "b" | "c" | "d" | "e" | "f" | "g" | "h" | "i" | "j" | "k" | "l" | "m" | "n" | "o" | "p" | "q" | "r" | "s" | "t" | "u" | "v" | "w" | "x" | "y" | "z"
<digit>	:=	"0" | "1" | "2" | "3" | "4" | "5" | "6" | "7" | "8" | "9"
<sign>	:=	"+" | "-"

[1]Redundant delimiters in a <delimiter string> are ignored and do not count toward any length limits. For a <command string>, redundant delimiters include all leading delimiters, all trailing delimiters after the carriage return, and any instance of more than one <delimiter> in a <delimiter string> between the <command name> and the carriage return.

[2]This is not a complete definition. The items on the left can take on a limited range of values (see Section 5).

The formal description above omits the 255-character limit and the equivalency of lower and upper case.

4.3.3 ASCII parameter value formats

ASCII interface parameter values include numeric parameters and decimal integer representations of bit fields. Their formats are discussed below.

Numbers

Numeric parameters include device numbers, mode numbers, time periods, and error numbers. These are passed in decimal format, which is defined as:

- an optional sign ("+" or "-") followed by a string of decimal digits (for numbers without fractional parts);

or:

- an optional sign ("+" or "-") followed by an optional string of decimal digits followed by "." followed by a mandatory string of decimal digits (for numbers with fractional parts);

Note that by these definitions "5", "0.5", and ".5" are legal but "5." is not (a decimal point with no fractional part).

Bit fields

A bit field is represented as a decimal integer. The integer is the sum of the bit values in the field.

For example, the support value returned by **syGetState** is derived by treating the Boolean supported/not supported values as elements in a bit field. Table 4–2 lists the decimal numbers returned for the different service groups. The value of the bit field is the sum of the values for each group. (Note that the system (sy) group is always present if VDI Management is working.)

Table 4–2. ASCII bit field values

Service group	Decimal value returned by syGetState
System (sy)	1
Visual management (vm)	2
Videodisc (vd)	4
XY input (xy)	8

Assume a system supports vm and vd, but not xy commands. The **syGetState** return value is 1 + 2 + 4 or decimal 7. If all command groups are supported, the return value is 15.

Text

Some return strings for query parameters include values other than numbers. These strings consist of at most upper-case alpha characters, decimal digits, commas, the decimal point, and a sign (+ or -).

4.3.4 Device driver buffer behavior

The way in which the device driver buffers character strings must be compatible across different versions of MS–DOS. When the driver loads it allocates a command buffer and a response buffer. At start-up, the command buffer is empty and the response buffer contains the string "ERROR 19" (Device driver read before write). If an application tries to read the driver before writing to it, the application reads this string.[1]

When the driver receives a character, it adds it to the command buffer and checks to see if it is a CR. If it is not, the driver returns. If it is, the driver and VDI Management process the contents of the command buffer, execute the command, and generate a response string. The response string replaces any existing contents of the response buffer.

When MS–DOS tries to read a character from the driver, the driver checks the response buffer. If the buffer contains characters, the driver returns the first character and deletes it from the buffer. If the buffer is empty, the driver returns end of file (EOF).

Some programming languages internally buffer device driver writes and do not furnish a way to flush the buffer other than closing the file to which it is attached. Users of such languages must be able to force a write to the driver without losing the response to the forced write. Therefore, closing and reopening the driver empties the command buffer but does not change the contents of the response buffer.

If one application ends and a new application starts, the driver does not flush the response buffer until it receives a CR. Therefore, an application should not read the driver before writing at least one command or it may read an invalid response left by the previous application.

If an application writes a command longer than 255 characters, the driver discards the command by clearing the buffer and ignoring additional characters up to the next CR. The driver then issues "ERROR 17" (Command too long).

1. Note that this applies only to the first time an application accesses the driver after boot time. The response buffer is not automatically reset to "ERROR 19" after an application exits.

4.3.5 Device driver IOCTL and mode options

Developers must make several choices about which functions to provide with MS–DOS device drivers. These include support for IOCTL functions, output until busy, and generic IOCTL commands.

Although the recommended practices do not require any of these capabilities, the device drive may furnish them and still be compliant. For example, a driver might use IOCTL commands to switch between an compliant mode and a dedicated, nonportable mode. *However, applications that use these facilities are noncompliant because the facilities are not part of the recommended practices and may not be supported.*

Another choice is whether device drivers should operate in ASCII ("cooked") or binary ("raw") mode.[2] The driver should work properly using either mode because applications may choose either and be compliant.

Application authors should note that MS–DOS interrupt 21H supports two classes of file functions. One class manipulates files with file handles; the other uses CP/M-compatible file control blocks. Only the read/write functions that use handles work with device drivers.

This does not mean that routines within a programming system must explicitly pass handles to the application. However, the system should not use MS–DOS interrupt 21H functions 0F, 10–17, 1A, 21–24, 27, and 29H, which work with file control blocks. This is unlikely to be an issue because using file handle functions has been the method of preference since the introduction of MS–DOS 2.0.

4.4 Binary interface issues

Binary interface issues include establishing which interrupt will be used and parameter value formats. The following subsections cover these issues.

4.4.1 Setting the software interrupt

The binary interface software interrupt is a user interrupt in the range 60H to 66H. The default is interrupt 60H. When VDI Management loads, it checks the environment space for the variable IVINT. The variable value is a two-

2. In cooked mode, certain characters such as control characters and EOF are subject to MS–DOS interpretation; in raw mode, they are not. A device driver that is opened with the MS–DOS open handle function, Int 21H function 3DH, is by default in cooked mode. However, an MS–DOS IOCTL function, Int 21H function 44H, can force a handle to raw mode.

character string representing a value from 60H through 66H. The variable is set with a command line in the autoexec.bat file, for example:

```
set IVINT=66
```

If the variable is set, VDI Management loads its interrupt handler at the specified vector. If the variable is not set, the handler is loaded at vector 60H. If the variable value is invalid, VDI Management politely declines to execute.

When an application starts, it also checks for IVINT. If the variable is present, the application uses the specified software interrupt. If IVINT is not present, the application uses the default. If the variable value is invalid, the application politely declines to execute.

4.4.2 Binary parameter value formats

Binary parameter values include integers, real numbers, bit fields, strings, pointers, and color arrays. These formats are discussed below.

Integers

Integer quantities are passed as 32-bit, 2's complement, signed numbers, in the range -2,147,483,648 to +2,147,483,647. This is consistent with most high-level programming languages. Examples of integers include device numbers, graphics mode numbers, and error numbers.

Real numbers

Real numbers are passed by multiplying the real number by 65,536, rounding towards negative infinity, and using the integer part expressed in hexadecimal with 2's complement. Four bytes can represent fractional numbers in the range -32768 (80000000H) to +32767.99998 (7FFFFFFFH) with an accuracy of ±1/65536 (±0.000015).

In this notation, the most significant 16 bits represent the integer part of the number in 2's complement. The least significant 16 bits represent a *positive* binary fraction to be added to that integer. For example, to represent -½, set the most significant 16 bits to FFFFH or -1 decimal and the least significant 16 bits to 8000H or +½ decimal.

Normal 2's complement addition and subtraction still yields correct results. For example:

```
FFFF8000 (-½) + FFFF4000 (-¾) = FFFEC000 (-1¼)
FFFF4000 (-¾) + 00020000 (+2) = 00014000 (1¼)
00001999 (0.1) + 00003333 (0.2) = 00004CCC (0.299988)
```

Bit fields

Bit fields are best viewed as 32 individual bits that can each take a value of 0 or 1. Specific bits in a field correspond to specific items of information that can have only two states, on or off, true or false, or present or absent.

Table 4–3 lists bits in the bit field returned by **syGetState**. This function sets bits according to which service groups are present in a VDI Management installation. (Note that the system (sy) group is always present if VDI Management is working.)

Table 4–3. Binary bit field values

Service group	Least significant byte value is group if present	
	Binary	Hexadecimal
System (sy)	00000001	01
Visual management (vm)	00000010	02
Videodisc (vd)	00000100	04
XY input (xy)	00001000	08

For example, if the VDI implementation supports vm and vd commands, but not xy, the least significant byte returned by **syGetState** is 00000111B or 07H. (See Appendix C for a code fragment showing how to analyze bit fields.)

Strings

Strings returned via the binary interface are passed by reference. The return value is a pointer to an ASCII string of up to 255 printable characters followed by a null character (00H). Alphabetical characters in the return string are upper case. The most significant 16 bits of the pointer contain the string's segment address; the least significant 16 bits contain the offset within the segment.

> VDI Management allocates memory to hold return strings. An application should not change this memory even though it knows the string's address or dire consequences may result.

Color arrays

The **vmGetPalette** and **vmSetPalette** commands use arrays containing palette information. These arrays are passed by reference. The parameter packet contains three parameters, a logical color parameter, a length parameter, and a array address parameter.

The **array** parameter value is a long pointer to a memory block containing an array of palette colors. Each palette color value is a 32-bit structure containing four 1-byte values:

- Byte 0, the least significant byte, represents B(lue);
- Byte 1 represents G(reen);
- Byte 2 represents R(ed); and
- Byte 3, the most significant byte is reserved and is set to zero.

The reserved byte **must** be set to zero—VDI Management returns error 51 (Parameter value invalid or out of range) if it is not.

The **length** parameter is the number of 32-bit structures in the color array. The **color** parameter is the logical color number to which the first palette color structure is assigned. The second palette color structure is assigned to the next contiguous logical-color number; the third structure to the third logical color; and so on up to **length** logical colors.

Assume a parameter packet contains **logical color** = 4, **length** = 3, and **array** = 3000:0820. The array memory block is interpreted as:

3000:0820 32-bit word for logical color 4
3000:0824 32-bit word for logical color 5
3000:0828 32-bit word for logical color 6

The pointer format is the same as that for a string—the most significant 16 bits contain the segment address and the least significant 16 bits contain the offset within that segment.

5 Command set summary tables

This section includes summary tables of the commands and parameters for both the ASCII and binary interfaces with token numbers for the binary interface. See Section 3 for detailed information on how to use the interfaces and Sections 4.3 and 4.4 for information on ASCII string syntax and ASCII and binary parameter value formats. Appendixes C and D provide programming examples and cover error handling, respectively.

5.1 Command names and token numbers

The binary interface uses token numbers instead of command names. These numbers map directly to ASCII command equivalents in terms of definition and functionality. To assign binary token numbers, each ASCII command name is first divided into a service group prefix, such as sy or vm, and a command word, such as GetState or Init.

Table 5–1 lists the prefix value of each service group. As the table shows, service-group prefixes have values that are multiples of 1024 (0400H). This has the advantages of leaving room for logically grouping additional commands as the recommendations evolve and allowing the determination of which service group an token number is in with a single shift right and compare operation.

Table 5–1. Service group prefix values for the binary interface.

Service group prefix	Value (decimal)	Value (hexadecimal)
sy	1024	0400
vm	2048	0800
vd	3072	0C00
xy	4096	1000

Table 5–2 lists the value for each command word. Commands words are numbered 1–20 in alphabetical order. However, because the numbers must be "cast in stone" for backwards compatibility, new words will be appended to the list and the correspondence of alphabetical order to numeric order will not be maintained as the recommended practices evolve. This approach offers the advantages of the ability to determine the command word by simply subtracting the service group value and looking up the word and the increased efficiency of contiguous numbers in a lookup table.

Table 5–2. Command word values for the binary interface

ASCII name	Value (decimal)	Value (hexadecimal)
CheckError	1	01
ErrorMsg	2	02
Fade	3	03
GetInput	4	04
GetPalette	5	05
GetState	6	06
Init	7	07
PassThru	8	08
Play	9	09
Queue	10	0A
Scan	11	0B
Search	12	0C
Set	13	0D
SetGraphics	14	0E
SetPalette	15	0F
SetTrans	16	10
SetVideo	17	11
Step	18	12
Still	19	13
Stop	20	14

Table 5–3 lists ASCII commands and their equivalent binary token numbers organized by service group. Each token number is the sum of the service-group prefix value and the command word value. For some commands, this offers the advantage of deriving token numbers from different prefixes that use the same command word. For example, in C a series of #define statements might include:

```
#define SY 1024
#define VM 2048
#define INIT 7
```

Then, the token number for **syInit** could be derived with:

SY + INIT

The table also indicates whether the commands are core or extended. Core commands must be implemented for a given service group to be compliant. Extended commands are optional and should be considered nonportable unless an application is written to use them if present and handle their absence.

Table 5–3. A summary of command names including binary token numbers and types

ASCII name	Token number (decimal)	Token number (hexadecimal)	Type
sy service group			
syCheckError	1025	0401	Core
syErrorMsg	1026	0402	Extended
syGetState	1030	0406	Core
syInit	1031	0407	Core
syQueue	1034	040A	Core
syStop	1044	0414	Core
vm service group			
vmFade	2051	0803	Core
vmGetPalette	2053	0805	Core
vmGetState	2054	0806	Core
vmInit	2055	0807	Core
vmSetGraphics	2062	080E	Core
vmSetPalette	2063	080F	Core
vmSetTrans	2064	0810	Core
vmSetVideo	2065	0811	Core
vd service group			
vdGetState	3078	0C06	Core
vdInit	3079	0C07	Core
vdPassThru	3080	0C08	Core
vdPlay	3081	0C09	Core
vdScan	3083	0C0B	Core
vdSearch	3084	0C0C	Core
vdSet	3085	0C0D	Core
vdStep	3090	0C12	Core
vdStill	3091	0C13	Core
xy service group			
xyGetInput	4100	1004	Core
xyGetState	4102	1006	Core
xyInit	4103	1007	Core
xySet	4109	100D	Core

5.2 Parameter names and token numbers

Parameter numbers are contiguous starting with one. The majority of parameter token numbers map to ASCII parameter names. However, some binary parameter numbers such as **array** and **length** have no ASCII equivalents.

Table 5–4 lists parameter names and their binary token numbers. Parameters are numbered 1–67 in alphabetical order. However, because the numbers must be "cast in stone" for backwards compatibility, new parameters will be appended to the list and the correspondence of alphabetical order to numeric order will not be maintained as the recommended practices evolve.

The table also indicates whether the parameters are core or extended. Core parameters for a given service group must be implemented for compliance. Extended parameters are optional and should be considered nonportable unless an application is written to use them if present and handle their absence.

Table 5–4. A summary of parameter labels including binary token numbers

Parameter name	Token number (decimal)	Token number (hex)	Parameter name	Token number (decimal)	Token number (hex)
array	1	01	motion	35	23
audio1	2	02	physcolors	36	24
audio2	3	03	pmsg	37	25
b	4	04	r	38	26
buttons	5	05	remote[2]	39	27
cdisplay	6	06	speed	40	28
chapter	7	07	spin	41	29
clear	8	08	state	42	2A
color	9	09	support	43	2B
command	10	0A	tbuttons	44	2C
cursor[1]	11	0B	tdevices	45	2D
defdevice	12	0C	tsources	46	2E
defsource	13	0D	time	47	2F
device	14	0E	to	48	30
direction	15	0F	transcolors	49	31
disctype	16	10	vertpix	50	32
dlevel	17	11	video	51	33
door[2]	18	12	vlevel	52	34
emulation	19	13	vmode	53	35
enable	20	14	wait	54	36
errno	21	15	width[3]	55	37
execute	22	16	xmax	56	38
frame	23	17	xmaxclip	57	39
from	24	18	xmin	58	3A
g	25	19	xminclip	59	3B
glevel	26	1A	xoffset	60	3C
gmode	27	1B	xpos	61	3D
horzpix	28	1C	ymax	62	3E
idxdsiplay	29	1D	ymaxclip	63	3F
ivver	30	1E	ymin	64	40
length	31	1F	yminclip	65	41
logcolors	32	20	yoffset	66	42
mfgname	33	21	ypos	67	43
mfgver	34	22			

[1]Currently used only as an extended parameter in the xy service group.

[2]Currently used only as an extended parameter in the vd service group.

[3]Currently used only as an extended parameter in the vm service group.

6 System commands (sy)

This section describes commands that relate to overall VDI software operation. These commands initialize the basic IV system (but not other service groups); obtain specific information about system software and its configuration; retrieve error information; queue commands for subsequent execution; and free resources when the VDI software is not in use. Table 6–1 lists the commands covered in this section, their token numbers, and their types.

Table 6–1. System command names, token numbers, and types

ASCII command name[1]	Binary interface token number (decimal)	Type[2]
syCheckError	1025	Core
syErrorMsg	1026	Extended
syGetState	1030	Core
syInit	1031	Core
syQueue	1034	Core
syStop	1044	Core

[1] Upper or lower case for command names is not significant.
[2] Compliant implementations must support "Core" commands. Supporting "Extended" commands is optional, and these commands should be considered nonportable unless properly handled when absent.

syCheckError

Last revision: R 1.0

Type: *core*

Parameters

ASCII

Parameter	Core or extended	Associated calling value	Type as ASCII	Associated return value	Type as ASCII	Default if parameter not used
command	Core	None	N/A	Command name that caused error	Text	No action
errno	Core	None	N/A	Last detected error number	Integer	No action
At least one parameter is required or an error is returned.						

Binary

Command code: 1025 decimal.

Parameter	Core or extended	Token number (decimal)	Type	Associated calling value	Associated return value	Default if parameter not used
command	Core	10	Integer	Any value	Command token that caused error	No action
errno	Core	21	Integer	Any value	Last detected error number	No action
At least one parameter is required or an error is returned.						

Description

Summary

syCheckError returns the number of the last error detected by VDI Management, if present, and the command that caused the error. **syCheckError** then clears this error information.

General discussion

VDI Management may detect errors that do not occur in immediate response to application commands. Such errors may occur, for example, after player motion commands, fade and dissolve commands, queued commands, and others that execute over time after being accepted. **syCheckError** is provided to detect these types of errors, although it will return the last error regardless of the error's cause.

syCheckError

Assume a player accepts a valid **vdPlay** command without a **wait** modifier (see Section 8). VDI Management will return success immediately ("OK" for the ASCII interface, AX =0 for the binary interface). If the player then fails during the specified motion sequence, an error state exists. **syCheckError** determines if such a situation has arisen and, if so, returns the error. Similarly, if a fade is successfully initiated and subsequently fails, an unreported error results. Finally, a queued command may result in an error although **syQueue execute** was successful. **syCheckError** returns the error resulting from the queued command. However, the return **does not** specify which queued command generated the error.

Implementation notes

While actual implementations may vary in the way they store and translate the information needed by **syCheckError**, in concept VDI Management maintains three buffers for returning error information, the response buffer, the check error buffer, and the check command buffer. The contents of these buffers (or the translations thereof) depends on which interface is used.

For the ASCII interface:

- the response buffer contains the return string for the most recent command, either "ERROR n..." where "n..." is an error number, "OK", or requested information;
- the check error buffer contains the error number as "n..." of the most recent error caused by any command or "0" if no error has occurred or the buffer has been cleared; and
- the check command buffer contains the name of the command that caused the error or "OK" if no error has occurred or the buffer has been cleared.

For the binary interface:

- the response buffer contains the value to be returned in the AX register for the most recent command, either an error number or zero if no error occurred;
- the check error buffer contains the error number of the most recent error caused by any command or zero if no error has occurred or the buffer has been cleared; and
- the check command buffer contains the token number of the command that caused the error or zero if no error has occurred or the buffer has been cleared.

Command parameter

The **command** parameter requests the command that caused the last error, if present. Issuing **syCheckError** with **command** clears the error number in the check number buffer as well as the command name or token in the check command buffer.

syCheckError

Errno parameter

The **errno** parameter requests the error number of the last error detected. Issuing **syCheckError** with **errno** clears the command name or token in the check command buffer as well as the error number in the check number buffer.

Notes

1. **syCheckError** does not queue errors. For example, if a player motion command resulting in an unreported error is followed by a fade command resulting in an unreported error, the unreported error for the player motion command is lost.
2. Only **syCheckError** and **syInit** can clear the check error and check command buffers. However, **syInit** also reinitializes VDI Management, clearing the queue, canceling any pending commands, and setting up interrupts. Therefore, it **should not** be used simply to clear an error state.
3. If **syCheckError** itself causes an error because, for example, it is issued with an invalid parameter, it does not clear the check buffers. Instead, VDI Management loads the check error and check command buffers with the same information it would load for any other command causing an error. A subsequent correct call to **syCheckError** returns and clears this information.
4. Trying to queue **syCheckError** causes error 177 (Command cannot be queued) at the time of the attempt.

Returns

ASCII

On success: For **errno** parameter, last error number as "n..." or "0" if no error. For **command** parameter, name of command causing last error as an upper-case alpha string or "OK" if no error.

On failure: "ERROR n...".

Binary

On success: AX = 0. Value associated with the **errno** parameter is the last error number as a 32-bit integer or 0 if no error. Value associated with the **command** parameter is the token number of the command that caused the error or 0 if no error.

On failure: AX = error number. Any return values in the parameter block addressed by ES:DI are undefined and should be ignored.

See also:

syErrorMsg, syInit, syQueue.

syCheckError

Examples

ASCII

Pass non-syCheckError command that causes an error

```
syErrorMsg errno
   (returns) "ERROR 53"                    ; Missing parameter value
```

Now query for last error and related command

```
syCheckError errno, command
   (returns) "53,SYERRORMSG"               ; clears all last error information
```

Requery after clearing

```
syCheckError errno, command
   (returns) "0,OK"
```

Binary

Query for last error and related command token

```
AX          1025          ; syCheckError decimal ID
BX          1             ; number of parameters (required for return)
ES:DI[0]    21            ; errno decimal ID
ES:DI[4]    any value     ; place holder for value on return
ES:DI[8]    10            ; command decimal ID
ES:DI[C]    any value     ; place holder for value on return
```

After return

```
AX          0             ; returns 0 if successful (nonzero if not)
ES:DI[4]    error no.     ; number of most recent error, if present
                          ; (zero if no error, undefined if AX≠0)
ES:DI[C]    token no.     ; token number of command causing error
                          ; (zero if no error, undefined if AX≠0)
```

syErrorMsg

Last revision: R 1.0
Type: extended

Parameters

ASCII

Parameter	Core or extended	Associated calling value	Type as ASCII	Associated return value	Type as ASCII	Default if parameter not used
errno	Core	Error number	Integer	Error description string	Text	Causes error
Errno must be specified or an error is returned.						

Binary

Command code: 1026 decimal.

Parameter	Core or extended	Token number (decimal)	Type	Associated calling value	Associated return value	Default if parameter not used
errno	Core	21	Integer	Error number	None	Causes error
pmsg	Core	37	Pointer	Any value	Pointer to error description string	Causes error
Both parameters must be specified or an error is returned.						

Description

Summary

syErrorMsg returns an ASCII string of up to 255 characters that describes the specified error number.

General discussion

When an ASCII interface command causes an error, the error is reported as "ERROR n..." where "n..." is the error number expressed in ASCII digits. The binary interface returns the error number in the AX register. Applications can use the error number with **syErrorMsg** to request a description. VDI Management developers may opt to keep error descriptions in memory or a separate file.

Errno parameter

The **errno** parameter specifies the error number for which a descriptive string will be returned.

Pmsg parameter

The **pmsg** parameter for the binary interface has an associated return value that points to the location of the descriptive string.

syErrorMsg

Notes

1. Appendix D lists strings for specific error numbers.
2. Trying to queue **syErrorMsg** causes error 177 (Command cannot be queued) at the time of the attempt.

Returns

ASCII

On success: Error description string.

On failure: "ERROR n...".

Binary

On success: AX = 0. Value associated with the **pmsg** parameter is a 32-bit pointer to a null-terminated error description string.

On failure: AX = error number. Any return values in the parameter block addressed by ES:DI are undefined and should be ignored.

See also:

syCheckError, syQueue.

Examples

ASCII

Pass an invalid parameter

syErrorMsg error=55
(returns) "ERROR 48"

Get string describing error 48

syErrorMsg errno=48
(returns) "UNKNOWN PARAMETER"

Pass insufficient parameters

syErrorMsg
(returns) "ERROR 49"

Get string describing error 49

syErrorMsg errno=49
(returns) "INSUFFICIENT PARAMETERS"

Binary

Get string describing error 176

```
AX          1026        ; syErrorMsg decimal ID
BX          2           ; number of packets
ES:DI[0]    21          ; errno decimal ID
ES:DI[4]    176         ; decimal error number
ES:DI[8]    37          ; pmsg decimal ID
ES:DI[C]    any value   ; place holder for value on return
```

After return

```
AX          0           ; returns 0 if successful (nonzero if not)
ES:DI[C]    pointer     ; pointer to message string
```

syGetState

Last revision: R 1.0
Type: core

Parameters

ASCII

Parameter	Core or extended	Associated calling value	Type as ASCII	Associated return value	Type as ASCII	Default if parameter not used
ivver	Core	None	N/A	Recommended practices version number	Real	No action
mfgname	Core	None	N/A	MFG name[1]	Text	No action
mfgver	Core	None	N/A	MFG version[1]	Text	No action
support	Core	None	N/A	Value of bit field for installed service groups	Integer	No action
At least one parameter is required or an error is returned.						

[1]Eight characters ma . Restricted to printable characters and **cannot** include white space (ASCII 20H, C9H), backspace (ASCII 08H), a comma (ASCII 2CH), CR (ASCII 0DH), or LF (ASCII 0AH).

Binary

Command code: 1030 decimal.

Parameter	Core or extended	Token number (decimal)	Type	Associated calling value	Associated return value	Default if parameter not used
ivver	Core	30	Real	Any value	Recommended practices version number	No action
mfgname	Core	33	Pointer	Any value	Pointer to MFG name string[1]	No action
mfgver	Core	34	Pointer	Any value	Pointer to MFG version string[1]	No action
support	Core	43	Bit field	Any value	Bit field of installed service groups	No action
At least one parameter is required or an error is returned.						

[1]Eight characters max. Restricted to printable characters and **cannot** include white space (ASCII 20H, 09H), backspace (ASCII 08H), a comma (ASCII 2CH), CR (ASCII 0DH), or LF (ASCII 0AH).

syGetState

Description

Summary

syGetState returns supported service groups for which VDI Management was configured at installation, the version of the recommended practices supported, and manufacturer name and version information.

Ivver parameter

The **ivver** parameter returns the version number of the recommended practices with which the VDI Management software complies. IV applications can use this number to determine compatibility with VDI Management implementations. An application that requires a given version number will also be compatible with any higher version number.

Mfgname and mfgver parameters

The **mfgname** and **mfgver** parameters return the VDI Management manufacturer's name and software version number respectively. This information is required to confirm compliance with the recommendations and for software maintenance purposes to obtain the manufacturer and version number for technical support. An application may also use this information to determine if a particular implementation that provides extended commands is present.

The **mfgname** and **mfgver** return strings are eight-character strings of printable characters. The strings **cannot** include white space (ASCII 20H, 09H), backspace (ASCII 08H), a comma (ASCII 2CH), CR (ASCII 0DH), or LF (ASCII 0AH).

Support parameter

The **support** parameter returns a bit field or an ASCII representation thereof that specifies service groups that are supported and for which VDI Management was configured during software installation. An application should typically issue **syGetState support** immediately after **syInit** to find out if software support exists for required service groups. Typically, an application will then issue the specific **xxInit** command for each represented service group that the application will use. The **xxInit** commands for individual service groups initialize software support for devices within the group and verify communications with the requisite hardware.

The following table shows return values for each service group after an **syGetState support**. The actual value returned is the sum of the listed values for all installed service groups. For example, a binary status return of 00000111B means that system, visual management, and videodisc are supported, but XY input is not. An ASCII return value of "7" means the same.

syGetState

Service Group	Binary interface return value (low byte)	ASCII interface return value
System (sy)	00000001	1
Visual management (vm)	00000010	2
Videodisc (vd)	00000100	4
XY input (xy)	00001000	8

Parameters resulting in errors

If a parameter causes an error, **syGetState** returns immediately with an error message. The command does not return partial responses for other parameters that do not cause errors.

Notes

1. Values for **mfgname** and **mfgver** are not under the control of the recommended practices. (In the future, **mfgname** may be required to be unique and registered.)
2. Trying to queue **syGetState** causes error 177 (Command cannot be queued) at the time of the attempt.

Returns

ASCII

On success: Comma-separated string with response for each specified parameter as described above.

On failure: "ERROR n...".

Binary

On success: AX = 0. Value associated with **support** parameter is a 32-bit bit field as described above. Value associated with **ivver** is a 32-bit real. Values associated with **mfgname** and **mfgver** parameters are pointers to null-terminated strings as described above.

On failure: AX = error number. Any return values in the parameter block addressed by ES:DI are undefined and should be ignored.

See also:

syQueue, vdGetState, vdInit, vmGetState, vmInit, xyGetState, xyInit.

syGetState

Examples

ASCII

Get services supported by installed system

```
syGetstate support
  (returns) "15"          ; system, visual management, videodisc, and XY
                          ; commands supported
```

Get version number of recommendations

```
syGetstate ivver
  (returns) "1.0"         ; conforms with recommended practices
                          ; standard, version 1.0
```

Get manufacturer and version

```
syGetstate mfgname,mfgver
  (returns) "IVMAKER,1.3"     ; VDI Management written by IVMAKER,
                              ; version 1.3
```

Binary

Get services supported by installed system

```
AX          1030        ; syGetState decimal ID
BX          1           ; number of packets
ES:DI[0]    43          ; support decimal ID
ES:DI[4]    any value   ; no associated value
```

After return

```
AX          0           ; returns 0 if successful (nonzero if not)
ES:DI[4]    bit field   ; support parameter bit field
```

syInit

Last revision: R 1.0
Type: core

Parameters

ASCII No parameters.

Binary

Command code: 1031 decimal.

No parameters.

Description

Summary **syInit** initializes VDI Management and the **sy** service group and confirms communications between VDI Management and the application.

General discussion The specific actions taken by **syInit** are highly implementation dependent. However, regardless of the implementation, **syInit** does the minimum required to prepare the system for other VDI Management commands. It **does not** replace the initialization commands for other service groups. For example, **syInit** does not verify communications with a videodisc player or change the video display. However, it may need to attach proper interrupts to proper ports, set proper software interrupts, disable non-IV operating modes, and do other basic start-up chores. syInit also does the following specific initialization tasks:

- Sets the default logical device or logical source for all service groups to zero.
- Clears the error buffers used by **syCheckError**.
- Issues **syQueue clear,state=0** to clear the command queue and turn it off.

Notes

1. Application programs should make **no** assumptions about the state of the IV system or the presence of service groups after **syInit**. To determine which service groups are present and enable the groups, an application should:
   a. Issue **syInit**.
   b. Issue **syGetState support** to determine which services are present.
   c. Issue the initialization commands for the service groups to be used by the application.

syInit

d. If required, initialize non-IV devices and allocate additional memory. (At the developer's discretion, these tasks may be done either before or after issuing **syInit** and other IV initialization commands.)

2. Because the specific actions taken by **syInit** are implementation dependent and affect the state of VDI Management, if an application reissues **syInit** after the start-up sequence given above, it should also repeat steps c and d above to ensure that the system is in a known state.

3. Trying to queue **syInit** causes error 177 (Command cannot be queued) at the time of the attempt.

Returns

ASCII

On success: "OK".

On failure: "ERROR n...".

Binary

On success: AX = 0.

On failure: AX = error number.

See also:

syCheckError, syGetState, syQueue, vdInit, vmInit, xyInit.

Examples

ASCII

```
Initialize VDI Management    syInit
                               (returns) "OK"
```

Binary

```
Initialize VDI Management    AX    1031    ; syInit decimal ID
                             BX    0       ; no parameters

After return                 AX    0       ; returns 0 if successful (nonzero if not)
```

syQueue

Last revision: R 1.0

Type: core

Parameters

ASCII

Parameter	Core or extended	Associated calling value	Type as ASCII	Associated return value	Type as ASCII	Default if parameter not used
clear	Core	None	N/A	None	N/A	No action
execute	Core	None	N/A	None	N/A	No action
state	Core	1 (on) | 0 (off)	Integer	None	N/A	No action
At least one parameter is required or an error is returned.						

Binary

Command code: 1034 decimal.

Parameter	Core or extended	Token number (decimal)	Type	Associated calling value	Associated return value	Default if parameter not used
clear	Core	8	N/A	Any value	None	No action
execute	Core	42	N/A	Any value	None	No action
state	Core	42	Integer	1 (on) | 0 (off)	None	No action
At least one parameter is required or an error is returned.						

Description

Summary

syQueue manages a fixed-length internal queue with exactly 10 slots for storing at most 10 commands. The queue can be turned on and off, cleared, and executed.

General discussion

syQueue stores commands in an internal queue for later execution. It may be used to collect commands that have critical timing requirements and should be executed together. One example is a set of changes that should occur during a vertical blanking interval to avoid screen disturbances, such as changing the palette and setting a transparent color. Queued commands are always executed in the order in which they were queued and, if possible, adjacent commands are executed in the same vertical interval.

syQueue

Clear parameter

The **clear** parameter clears the queue of all commands without executing them. **Clear** does not change the queue's **state** (on or off). If the queue is on when cleared, subsequent commands are accumulated until the queue is explicitly turned off.

Clearing an empty queue has no effect and is not an error.

Execute parameter

The **execute** parameter instructs VDI Management to execute all commands in the queue as quickly as possible. **syQueue execute** does **not** clear the queue or affect the queue's **on** or **off** state. A queue that has been turned off remains executable.

Executing an empty queue has no effect and is not an error.

State parameter

The **state** parameter turns the queue on and off. **State=1** instructs VDI Management to store at most 10 commands for later execution. If more than 10 commands are issued while the queue is on, the extra commands return error 176 (Queue full), and the commands in the queue are left intact.

State=0 instructs VDI Management to resume immediate execution of commands without storing them in the queue. Commands already in the queue remain unchanged and unexecuted.

Turning a queue on that is already on, or off that is already off has no effect and is not an error.

Combining parameters

The **execute** parameter always takes precedence. To execute commands and clear the queue use **syQueue clear execute** or **syQueue execute clear**. Because **execute** has the higher priority, **syQueue** acts on **execute** first in both examples. Similarly, **syQueue state=1 execute** and **syQueue state=0 execute** work as expected, executing the queue then turning it on or off, respectively.

syQueue

Unqueueable commands

The following commands cannot be queued either because requested information would be lost after **syQueue execute** or because their behavior could disrupt the queue or the execution of subsequent queued commands.

Unqueueable commands		
syCheckError	syStop	vmInit
syErrorMsg	vdGetState	xyGetInput
syGetState	vdInit	xyGetState
syInit	vmGetPalette	xyInit
syQueue	vmGetState	

If an application tries to queue an unqueueable command except **syQueue**, which executes immediately, the illegal command returns error 177 (Command cannot be queued) immediately. This error and error 176 (Queue full) are the only errors that can be returned while the queue is on. **syQueue** ignores the illegal command. It is **not** queued and does not affect the status of the queue. Similarly, if the queue is full, **syQueue** ignores all attempts to queue additional commands.

Queued commands resulting in errors

If a queued command results in an error, the error is not detected until **syQueue execute**. When the error is detected, **syQueue** returns immediately without executing any remaining commands in the queue. However, **syQueue** does **not** return an error. Therefore, it is good practice to issue **syCheckError** immediately after **syQueue execute** to determine if an error occurred during queue execution. This is the only systematic way to detect such errors.

Notes

1. **syQueue** always executes immediately and cannot be queued.
2. If **vmSetPalette** is queued, the pointer information in the command's parameter block is stored with the queue (see Section 7). However, the information in the palette array is not stored, but is read when the queue is executed. Therefore, if an application changes the contents of the palette array between issuing and executing the queued command, the modified array will be used. An application **should not** deallocate the memory for the palette array before clearing the queue. Doing so could load invalid palette information.

syQueue

3. Trying to queue more than 10 commands causes error 176 (Queue full). This error can be returned for any queueable command. Trying to queue any unqueueable command except **syQueue**, which executes immediately, causes error 177 (Command cannot be queued). Error 177 takes precedence over error 176.
4. An unknown command can be queued and will not return error 2 (Unknown command) until the queue is executed.

Returns

ASCII

On success: "OK".

On failure: "ERROR n...".

Binary

On success: AX = 0.

On failure: AX = error number.

See also:

vmSetPalette.

Examples

ASCII

Turn on queue and store commands

```
syQueue state=1
   (returns) "OK"
(command 1)
   (returns) "OK"
(command 2)
   (returns) "OK"
(command 3)
   (returns) "OK"
(command 4)                ; commands 1–4 are stored and not executed
   (returns) "OK"
```

Turn off queue and execute new commands immediately

```
syQueue state=0            ; subsequent commands are not queued
   (returns) "OK"
(command 5)
   (returns) "OK"
(command 6)
   (returns) "OK"
(command 7)                ; commands 5–7 are each executed immediately
   (returns) "OK"
```

syQueue

Execute queue, then unqueued commands	syQueue execute (returns) "OK" (command 8) (returns) "OK" (command 9) (returns) "OK"		; commands 1–4 are rapidly executed from the queue ; commands 8 and 9 are each executed immediately
Reexecute queue and clear	syQueue execute,clear (returns) "OK"		; commands 1–4 are rapidly executed and cleared

Binary

Turn on syQueue	AX	1034	; **syQueue** decimal ID
	BX	1	; number of parameters
	ES:DI[0]	42	; **state** decimal ID
	ES:DI[4]	1	; value for "on"
After return	AX	0	; Returns 0 if successful (nonzero if not)
Clear queue and stop accumulating commands	AX	1034	; **syQueue** decimal ID
	BX	2	; number of parameters
	ES:DI[0]	8	; **clear** decimal ID
	ES:DI[4]	any value	; no associated value
	ES:DI[8]	42	; **state** decimal ID
	ES:DI[C]	0	; value for "off"
After return	AX	0	; returns 0 if successful (nonzero if not)

syStop

Last revision: R 1.0
Type: Core

Parameters

ASCII No parameters.

Binary

Command code: 1044 decimal.

No parameters.

Description

Summary **syStop** frees all possible resources used by the interfaces and VDI Management to make the resources available for non-IV use.

General discussion **syStop** reduces the interfaces and VDI Management to their minimum possible configurations without actually unloading the VDI software. The command frees resources such as file handles and interrupts for use by non-IV applications. The command's actions are highly implementation and configuration dependent. **syStop** does not change the graphics mode, therefore, applications must handle the mode after exit separately. However, if VDI Management turned mode trapping on, which it typically would, **syStop** turns it off.

After an **syStop**, all VDI commands are undefined except **syInit**. Upon resumption of IV activities, an **syInit** must be issued before any other IV command.

Notes

1. An attempt to queue **syStop** causes error 177 (Command cannot be queued) at the time of the attempt.

Returns

ASCII

On success: "OK".

On failure: "ERROR n...".

Binary

On success: AX = 0.

On failure: AX = error number.

See also:

syInit, syQueue.

syStop

Examples

ASCII

Place VDI Management in inactive state	syStop (returns) "OK"	

Binary

Place VDI Management in inactive state	AX	1044	; **syStop** decimal ID
	BX	0	; no parameters
After return	AX	0	; returns 0 if successful (nonzero if not)

7 Visual-management commands (vm)

This section describes commands that relate to the visual management of the display screen. The commands in this section control the graphics display, video display, visual signal routing, video modes, and graphics modes. Table 7–1 lists the commands covered in this section, their token numbers, and their types.

Table 7–1. Visual-management command names, token numbers, and types

ASCII command name[1]	Binary interface token number (decimal)	Type[2]
vmFade	2051	Core
vmGetPalette	2053	Core
vmGetState	2054	Core
vmInit	2055	Core
vmSetGraphics	2062	Core
vmSetPalette	2063	Core
vmSetTrans	2064	Core
vmSetVideo	2065	Core

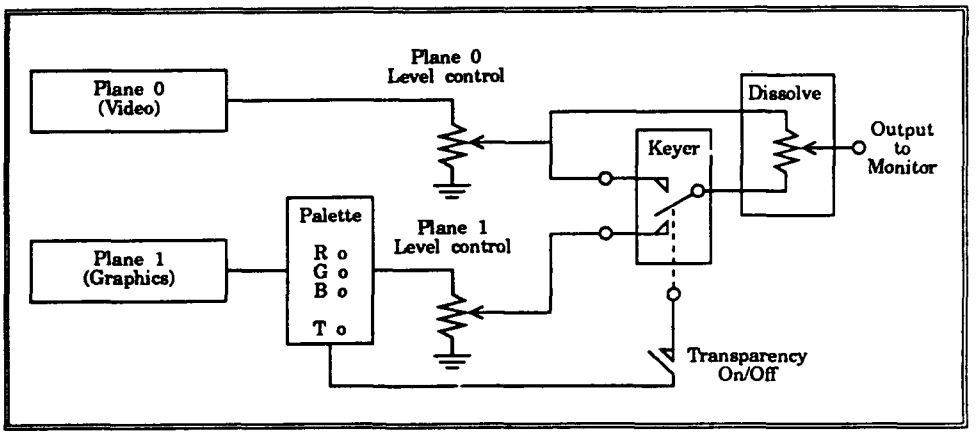
[1]Upper or lower case for command names is not significant.

[2]Compliant implementations must support "Core" commands.

7.1 Terms of reference

Figure 7–1 shows a basic conceptual definition of a video overlay subsystem. It is intended to convey the overlay card's functionality, but **not** the hardware implementation. The functionality applies to overlay boards that are either based primarily on graphics synchronized to a video signal or have the video corrected to match the graphics.

Figure 7–1. A simplified functional model of a video overlay subsystem



Notes:

1. The definition includes two sources, plane 0 (video) from an external source such as a videodisc player and plane 1 (graphics) from the computer. Each source has an associated level control or fader
2. The palette does logical-to-physical color conversion and controls transparency. It can be described in terms of logical colors (number of colors that can be simultaneously displayed) and physical colors (palette size).
3. The keyer is responsible for selecting either plane 0 or plane 1 at a pixel rate for output to the display.
4. The dissolve unit:
   a. In its simplest form is a switch between video only and graphics over video (a *graphics ON/OFF* capability).
   b. At the next level of complexity supports plane 0↔plane 1 cross-fades.
   c. In future systems may become a pixel-rate translucency setting controlled by a palette extension (not shown).

7.2 General information and assumptions

The general information and assumptions given in this subsection were used in the definition of the visual-management commands. The material below is based on Intel 80x86 processor architecture, MS–DOS compatible operating systems, and standard IBM-compatible graphics modes.

7.2.1 Overlayable graphics modes

Appendix B lists IBM-compatible graphics modes as they would be returned by BIOS interrupt 10H, service 0FH, including whether the modes are text or graphics, resolutions, the adapters that support them, and whether they are overlayable.

> Compliance requires that graphics modes zero through three are guaranteed to be overlayable when the selected video mode is NTSC or PAL.

This means that when the video mode is not set to "native," these modes are restricted to 200 lines regardless of the actual number of lines that would normally be displayed by a given monitor adapter. (See the **vmSetGraphics** and **vmSetVideo** commands.)

7.2.2 Mode trapping

The visual-management commands do not control trapping interrupt 10H. VDI implementers may, and probably should, implement mode trapping to protect against disruption of the graphics and background video by applications that change modes using direct interrupt 10H calls instead of using the VDI visual-management commands. This is especially important for applications that may use separate graphics function libraries and similar tools.

7.2.3 Genlock control

The ability to turn genlock on and off is not included in the command set. The recommended practices assume that all video inputs and graphics are synchronous at all times from the application's viewpoint. Controlling genlocking is a video device driver issue that is left to the VDI implementer.

7.2.4 Graphics registration to the background video

Appendix A gives detailed information on assumed positions of graphics relative to background video. The information in the appendix should furnish reliable registration within about two pixels both horizontally and vertically.

However, applications that have critical registration requirements should include a position reference frame to allow dynamic positioning of the graphics plane at run-time. The command set provides commands for varying the graphics origin both horizontally and vertically. An extended feature supports setting the total width of the active graphics.

7.2.5 VGA graphics versus CGA and EGA graphics

Some graphics modes, in particular 620 × 200 and 320 × 200 resolution modes, are displayed differently by VGA adapters versus CGA and EGA adapters. VGA adapters display these modes so that the width of the active graphics area is equal to the width of the background video. CGA and EGA adapters leave right and left borders in these modes. Therefore, for CGA and EGA applications to be portable to VGA-based systems, the VGA system

must have the ability to display these modes at full width and as they would be displayed by a CGA or EGA adapter. Appendix A gives detailed information on VGA emulation of CGA and EGA graphics displays.

Compliance requires VGA emulation of CGA and EGA graphics displays.

7.2.6 Logical versus physical colors

The visual-management commands distinguish between logical and physical colors. A typical computer cannot display all available colors simultaneously. For example, in VGA mode 19, the system can simultaneously display 256 colors taken from 262,144 possible colors. The visual management commands refer to the number of colors that can be displayed simultaneously, here 256, as the number of available logical colors. The commands refer to the total possible colors, here 262,144, as the number of available physical colors—this is also commonly called the palette size.

7.3 Rounding methods for fades and dissolves

The visual management **vmFade** command must be supported. However, *compliant VDI Management software can be developed for IV hardware without fade circuitry.* For systems with fade circuitry, variations in available fade levels must be treated consistently.

Applications pass fade levels to VDI Management as integers in the range 0–255, which represent full off and full on, respectively. Intermediate values represent a linear transition of intensity from full off to full on. Dissolve levels are also passed as integers, where 0 represents display of video only and 255 represents hard keying (transparent colors are full video, opaque colors are full graphics).

VDI Management allocates each available hardware setting a level in the range 0–255 and rounds passed values to the nearest possible level. For example, if the hardware furnishes four fade levels with intensities of full off, ⅓ on, ⅔ on, and full on, these are allocated the numeric values 0, 85, 170, and 255, respectively. Passed values in the range 0–42 are rounded to full off, 43–127 to ⅓ intensity, 128–212 to ⅔ intensity, and 213–255 to full on.

If a fader is uneven, rounding ranges are adjusted accordingly. For example, if a fader can do full off, ½ on, ¾ on, and full on only, these are allocated the values 0, 128, 192, and 255.

For fades that use nonzero time periods, the fade levels are calculated as:

$$current\ level = start\ level + \left(\frac{time\ since\ start}{fade\ duration} \times (end\ level - start\ level) \right)$$

The fade levels are then rounded in the usual way. Assume a fade from full off to full on over 2.55 seconds on a system that can fade to off, ⅓ on, ⅔ on, and full on. The fader stays off for the first 0.425 seconds, at ⅓ from 0.425 to 1.275 seconds, at ⅔ from 1.275 to 2.125 seconds, and at full on from 2.125 to 2.55 seconds. Note that noninteger fade levels round in the usual way.

Applications can assume that levels 0 and 255 are available. On a system with no fade or dissolve circuitry, VDI Management switches to full off for levels 0–127 and full on for 128–255.

Note: Application authors should not assume rounded times are exact. On typical systems, the resolution of the tick interrupt or system clock will restrict the accuracy of timings.

vmFade

Last revision: R 1.0

Type: core

Parameters

ASCII

Parameter	Core or extended	Associated calling value	Type as ASCII	Associated return value	Type as ASCII	Default if parameter not used
dlevel	Core	Dissolve level, 0–255	Integer	None	N/A	No action
glevel	Core	Graphics level, 0–255	Integer	None	N/A	No action
vlevel	Core	Video level, 0–255	Integer	None	N/A	No action
time	Core	Seconds for fade or dissolve	Real	None	N/A	0
wait	Core	None	N/A	None	N/A	No wait
Exactly one of **dlevel**, **glevel**, or **vlevel** must be specified or an error is returned.						

Binary

Command code: 2051 decimal.

Parameter	Core or extended	Token number (decimal)	Type	Associated calling value	Associated return value	Default if parameter not used
dlevel	Core	17	Integer	Dissolve level, 0–255	Actual level after rounding if required	No action
glevel	Core	26	Integer	Graphics level, 0–255	Actual level after rounding if required	No action
vlevel	Core	52	Integer	Video level, 0–255	Actual level after rounding if required	No action
time	Core	47	Real[1]	Seconds for fade or dissolve	None	0
wait	Core	54	N/A	None	None	No wait
Exactly one of **dlevel**, **glevel**, or **vlevel** must be specified or an error is returned.						

[1]See Section 4.4.2 for the hexadecimal representation of this value.

vmFade

Description

Summary

vmFade sets the absolute levels of the graphics plane (**glevel**) and the video plane (**vlevel**), and the relative levels of video to graphics (**dlevel**) displayed on the screen. The specified level parameter changes to the specified level value over the specified **time**. The command returns immediately or after the specified level is reached if **wait** is specified. (Figure 7–1 in Section 7.1 shows the relationship of the level parameters to a video overlay subsystem.)

General discussion

Actual levels may vary from requested levels depending on system capabilities. If a system supports less than 256 levels for a given level parameter, VDI Management rounds the requested level to the closest supported level. **vmGetState** returns the actual level that was set after any required rounding when **vmFade** has finished execution. Similarly, the binary version of **vmFade** returns the actual level that will be set after any rounding in the parameter packet. (See Section 7.3 for more information on rounding levels.)

Dlevel parameter

The **dlevel** parameter creates transitions or dissolves between video only and hard keying (transparent colors are full video, opaque colors are full graphics). The parameter can be used to go from all video to all graphics or, when set to middle values, to create "ghosting" or highlighted effects with video showing through graphics. If a system cannot do dissolves, it switches to all video when **dlevel** is 0–127 and to hard keying when **dlevel** is 128–255.

With **dlevel=0** the video plane only is visible. With **dlevel=255** nontransparent colors display graphics at full intensity and transparent colors display video only, assuming **vmSetTrans state=1** has been issued. Assuming **dlevel=255**, to create a transition from graphics only to video only, turn transparency off with **vmSetTrans state=0**, then issue **vmFade dlevel=0**.

Dlevel differs from **glevel** and **vlevel** (see below) in that it controls the *relative* mix of video and graphics. Unlike **glevel** and **vlevel**, **dlevel** lets graphics appear mixed with video so that video and graphics are both visible in a ratio determined by the **dlevel** parameter. In contrast, **glevel** and **vlevel** set the *total* amount of video or graphics signal used.

Because **dlevel** sets the ratio of video to graphics, it is affected by **glevel** and **vlevel** values. For example if **vlevel=0**, **vmFade dlevel=255** will display graphics at full intensity but will not display video because the video signal has been turned off.

vmFade

Glevel parameter The **glevel** parameter sets the absolute intensity of the graphics plane in the range 0 to 255 (full off to full on). If a system supports graphics on and off only, it switches graphics on if **glevel** is 128–255 and off if **glevel** is 0–127.

Vlevel parameter The **vlevel** parameter sets the absolute intensity of the video plane in the range 0 to 255 (full off to full on). If a system supports video on and off only, it switches video on if **vlevel** is 128–255 and off if **vlevel** is 0–127.

Time parameter The **time** parameter specifies the number of seconds over which the fade or dissolve occurs. If necessary, VDI Management rounds **time** to the nearest value the system supports.

The **time** parameter functions the same ev.. he hardware or system software does not support fades or dissolves.

Wait parameter If the **wait** parameter is specified, **vmFade** does not return until the fade or dissolve has reached the specified level value at the end of the specified **time**. If **wait** is not used, **vmFade** returns immediately and the fade or dissolve executes as a background task.

The **wait** parameter functions the same even if the system does not support fades or dissolves.

Notes

1. **vmGetState** issued with the appropriate level parameter returns the *current* dissolve or fade level. This command can be used to determine if a background fade is complete. However, when a fade or dissolve is complete, the value returned by **vmGetState** may not agree with the requested level because of rounding. Therefore, programmers should test for limits instead of exact values.

2. If a system cannot do fades or dissolves, it switches to level 255 when a level parameter is set to 128–255, and to level 0 when a level is set to 0–12[illegible]. However, this does not affect the **wait** and **time** parameters. For example, if the system is incapable of dissolves, after the commands:

```
vmFade dlevel=0
vmFade dlevel=255, time=60, wait
```

the system will remain at level 0 for 30 seconds, then switch to level 255, then return after another 30 seconds. (See Section 7.3 for more information on rounding times.)

vmFade

3. Only one level may be set with a single call to **vmFade**. However, vmFade commands can be queued with **syQueue** to create the effect of multiple, simultaneous fades and dissolves.

Returns

ASCII

On success: "OK".

On failure: "ERROR n...".

Binary

On success: AX = 0. Value associated with **dlevel**, **glevel**, or **vlevel** parameter is a 32-bit integer that gives the actual level that will bc set after rounding if required.

On failure: AX = error number.

See also:

syQueue, vmGetState, vmSetTrans.

Examples

ASCII

Dissolve to all video over 1.5 seconds, do not return until complete	vmFade dlevel=0,time=1.5,wait (returns) "0"
Set display to hard keying immediately	vmFade dlevel=255 (returns) "OK"
Set video and graphics to 50% relative intensity	vmFade dlevel=128 (returns) "OK"
Fade graphics to full intensity over 0.3 seconds	vmFade glevel=255,time=.3 (returns) "255"
Fade video to zero over 1 second, do not return until complete	vmFade vlevel=0,time=1,wait (returns) "0"
Set video to zero immediately	vmFade vlevel=0 (returns) "OK"

vmFade

Set video to half intensity immediately

vmFade vlevel=128
(returns) "OK"

Binary

Dissolve to 0 over 2.5 seconds and return when done

```
AX          2051        ; vmFade decimal ID
BX          3           ; number of parameters
ES:DI[0]    17          ; dlevel decimal ID
ES:DI[4]    0           ; dlevel value
ES:DI[8]    47          ; time decimal ID
ES:DI[C]    2.5         ; time value in seconds. See Section 4.4.2 for the
                        ; hexadecimal representation of this value.
ES:DI[10]   54          ; wait decimal ID
ES:DI[14]   any value   ; no associated value
```

After return

```
AX          0           ; returns 0 if successful (nonzero if not)
ES:DI[4]    0           ; actual level that will be set after rounding if required
```

vmGetPalette

Last revision: R 1.0

Type: core

Parameters

ASCII

Parameter	Core or extended	Associated calling value	Type as ASCII	Associated return value	Type as ASCII	Default if parameter not used
color	Core	Logical color number	Integer	None	N/A	Causes error
r	Core	None	N/A	Red value, 0–255	Integer	No action
g	Core	None	N/A	Green value, 0–255	Integer	No action
b	Core	None	N/A	Blue value, 0–255	Integer	No action
Exactly one **color** and at least one of **r**, **g**, and **b** are required or an error is returned.						

Binary

Command code: 2053 decimal

Parameter	Core or extended	Token number (decimal)	Type	Associated calling value	Associated return value	Default if parameter not used
color	Core	9	Integer	Logical color number	None	Causes error
r	Core	38	Integer	Any value	Red value, 0–255	No action
g	Core	25	Integer	Any value	Green value, 0–255	No action
b	Core	4	Integer	Any value	Blue value, 0–255	No action
length	Core	31	Integer	Number of color array entries[1]	Number of color array entries[1]	No action
array	Core	1	Pointer	Pointer to color array	Pointer to color array	No action
Either exactly one **color** and at least one of **r**, **g**, and **b** are required; or **color**, **length**, and **array** must be used together; or an error is returned.						

[1]color array entry = 4 bytes comprised of 3 components + reserved byte.

vmGetPalette

Description

Summary

vmGetPalette returns the amounts of red, green, and blue components in a specified logical color via the ASCII interface or one or more sets of component values for contiguous logical colors via the binary interface.

General discussion

vmGetpalette returns the proportions of the red, green, and blue components in a logical color as real numbers in the range 0–255 where 255 is fully saturated for each component. Component values are returned for single colors via the ASCII interface and for single or multiple colors via the binary interface depending on the calling parameters.

vmGetState logcolors returns the number of available logical colors (colors that can be simultaneously displayed). **vmGetState physcolors** returns the number of available physical colors (palette size). **vmSetPalette** assigns physical colors to logical colors, and **vmGetPalette** returns the component values for the assigned colors. For example, a system might support 16 logical colors from a palette of 4096 physical colors. Logical color 3 might be bright cyan with component values of **r=0, b=255, g=255.**

Color + r, g, and b parameters

These parameters apply to both the ASCII and binary interfaces. The **color** parameter defines the logical color number for which **r**, **g**, and **b** component values are returned. Logical color numbers range from zero to the value returned by **vmGetState logcolors** minus one.

Exactly one **color** parameter must be listed. Specifying **color** twice causes error 54 (Parameter used more than once), and omitting **color** or failing to include at least one of **r**, **g**, and **b** causes error 49 (Insufficient parameters).

Any or all of **r**, **g**, and **b** can be listed with a **color**. **vmGetPalette** returns a comma-separated list of the requested integer values via the ASCII interface or a 32-bit integer for each requested component via the binary interface.

Color + length and array parameters

The **length** and **array** parameters are available with the binary interface only. They furnish a way to pass a pointer to an array for storing a set of palette values in application memory. The value associated with **array** is a 32-bit pointer to a memory block containing one or more 4-byte structures. **Array** must point to memory allocated by the application. The contents of each structure in the palette array are:

- Byte 0, the least significant byte, represents blue.
- Byte 1 represents green.
- Byte 2 represents red.
- Byte 3 is reserved and **always** set to zero.

vmGetPalette

The **length** parameter specifies the number of 4-byte structures in the array. The values in the first structure of the array are for the logical color number specified by the **color** parameter. The second structure relates to **color+1**, the third to **color+2**, an so on up to the number of structures specified by **length**. (See Section 4.4.2 for more information about palette arrays.)

Parameters resulting in errors

If a parameter causes an error, **vmGetPalette** returns immediately with an error message. The command does not return partial responses for other parameters that do not cause errors.

Notes

1. Values returned by **vmGetPalette** may not exactly match values set with **vmSetPalette** because of rounding when **vmSetPalette** component values do not match the component levels available on a specific system. For example, a system with four levels per component (0, 85, 170, and 255) will return a component value of 85 even though the value specified by **vmSetPalette** was 50.
2. VDI Management does not maintain palette arrays that are directly accessible by applications. Palette arrays for **vmGetPalette** must be allocated by the application. To allocate memory in bytes for a palette array, use **length** × 4.
3. Trying to queue **vmGetPalette** causes error 177 (Command cannot be queued) at the time of the attempt.

Returns

ASCII

On success: Comma-separated list of requested **r**, **g**, and **b** component values in the range "0" to "255" for **color**.

On Failure: "ERROR n...".

Binary

On success: AX = 0. Values associated with **r**, **g**, and **b** parameters are 32-bit integers in the range 0–255 for **color**. Value associated with **length** parameter is a 32-bit integer giving the number of 4-byte structures in a palette array allocated by the application. Value associated with **array** parameter is a 32-bit pointer to the palette array. With **length** and **array**, the value associated with **color** is the first logical color in a contiguous series in the palette array.

On failure: AX = error number. Any return values in the parameter block addressed by ES:DI are undefined and should be ignored.

See also:

syQueue, vmGetState, vmSetPalette.

vmGetPalette

Examples

ASCII

Return values for all parameters for logical color 0

vmGetPalette color=0,r,g,b
(returns) "255,127,0" ; logical color 0 has red=255, green=127, blue=0

Return red component for logical color 1

vmGetPalette color=1,r
(returns) "170" ; logical color 1 has a red component of 170

Binary

Get green component value for color number 3

	AX	2053	; **vmGetPalette** decimal ID
	BX	2	; number of parameters
	ES:DI[0]	9	; **color** decimal ID
	ES:DI[4]	3	; color number
	ES:DI[8]	25	; **g** decimal ID
	ES:DI[C]	any value	; place holder for value on return
After return	AX	0	; returns 0 if successful (nonzero if not)
	ES:DI[C]	g value	; green value for color 3

Get color values from color 3 to 9 (binary interface only)

	AX	2053	; **vmGetPalette** decimal ID
	BX	3	; number of parameters
	ES:DI[0]	9	; **color** decimal ID
	ES:DI[4]	3	; first color to list in palette array
	ES:DI[8]	31	; **length** decimal ID
	ES:DI[C]	7	; number of color structures in palette array
	ES:DI[10]	1	; **array** decimal ID
	ES:DI[14]	pointer	; pointer to palette array in application memory
After return	AX	0	; returns 0 if successful (nonzero if not)
	ES:DI[14]	pointer	; pointer to same array with updated component values

vmGetState

Last revision: R 1.0
Type: core

Parameters

ASCII

Parameter	Core or extended	Associated calling value	Type as ASCII	Associated return value	Type as ASCII	Default if parameter not used
color	Core	Logical color number	Integer	1(transparent) | 0 (opaque)	Integer	No action
defsource	Core	None	N/A	Default video source, 0–15	Integer	No action
dlevel	Core	None	N/A	Current level, 0–255	Integer	No action
emulation	Core	None	N/A	1 (on) | 0 (off)	Integer	No action
enable	Core	None	N/A	1 (on) | 0 (off)	Integer	No action
horzpix	Core	None	N/A	Total horizontal pixels in current gmode	Integer	No action
glevel	Core	None	N/A	Current level, 0–255	Integer	No action
gmode	Core	None	N/A	Current graphics mode	Integer	No action
logcolors	Core	None	N/A	Total available	Integer	No action
physcolors	Core	None	N/A	Total available	Integer	No action
transcolors	Core	None	N/A	Total available	Integer	No action
tsources	Core	None	N/A	Total video sources installed, 0–15	Integer	No action
vertpix	Core	None	N/A	Total vertical pixels in current gmode	Integer	No action
vlevel	Core	None	N/A	Current level, 0–255	Integer	No action
vmode	Core	None	N/A	0 (native) | 1 (NTSC) | 2 (PAL)	Integer	No action
width	Extended	None	N/A	Graphics width in µs	Real	No action
xoffset	Core	None	N/A	Graphics offset in pixels	Integer	No action
yoffset	Core	None	N/A	Graphics offset in pixels	Integer	No action
At least one parameter is required or an error is returned.						

vmGetState

Binary

Command code: 2054 decimal.

Parameter	Core or extended	Token number (decimal)	Type	Associated calling value	Associated return value	Default if parameter not used
color	Core	9	Integer	Logical color number	1(transparent) | 0 (opaque)	No action
defsource	Core	13	Integer	Any value	Default video source, 0–15	No action
dlevel	Core	17	Integer	Any value	Current level, 0–255	No action
emulation	Core	19	Integer	Any value	1 (on) | 0 (off)	No action
enable	Core	20	Integer	Any value	1 (on) | 0 (off)	No action
glevel	Core	26	Integer	Any value	Current level, 0–255	No action
gmode	Core	27	Integer	Any value	Current graphics mode	No action
horzpix	Core	28	Integer	Any value	Total horizontal pixels in current gmode	No action
logcolors	Core	32	Integer	Any value	Total available	No action
physcolors	Core	36	Integer	Any value	Total available	No action
transcolors	Core	49	Integer	Any value	Total available	No action
tsources	Core	46	Integer	Any value	Total video sources installed, 0–15	No action
vertpix	Core	50	Integer	Any value	Total vertical pixels in current gmode	No action
vlevel	Core	52	Integer	Any value	Current level, 0–255	No action
vmode	Core	53	Integer	Any value	0 (native) | 1 (NTSC) | 2 (PAL)	No action
width	Extended	55	Real	Any value	Graphics width in µs[1]	No action
xoffset	Core	60	Integer	Any value	Graphics offset in pixels	No action
yoffset	Core	66	Integer	Any value	Graphics offset in pixels	No action
At least one parameter is required or an error is returned.						

[1]See Section 4.4.2 for the hexadecimal representation of this value.

vmGetState

Description

Summary

vmGetstate returns information about the state of the visual-management service group including the current settings of variable parameters and available resources such as palette size and number of video sources.

Color parameter

The **color** parameter requests the transparency setting for a specified logical color number. A return value of one means that the specified color is set to transparent; zero means the specified color is opaque. (See **enable** below).

Enable parameter

The **enable** parameter returns one if logically transparent colors are currently physically transparent to the video plane. Transparent colors are those which have been set to transparent with **vmSetTrans color=(logical color number),state=on**. After **vmSetTrans enable=1**, these colors reveal the video plane. After **vmSetTrans enable=0**, all graphics colors including transparent colors are visible and entirely cover the video plane.

Defsource parameter

The **defsource** parameter returns the default logical video source in the range 0–15. Note that a video source is always selected, but the source number does not necessarily equal the default device number. For example, logical player zero may be logical video source one. This mapping is determined at VDI installation/configuration time. The default video source is defined as source zero unless **vmSetVideo defsource** is used to change it.

Dlevel, glevel, and vlevel parameters

The **dlevel, glevel,** and **vlevel** parameters return **current** levels in the range 0–255 for the dissolve level, graphics plane, and the video plane, respectively. The return values are actual values and may differ from the values requested by **vmFade** because of rounding.

Note: The values returned by these parameters are the levels *at the time of the request*, which may not equal the requested or actual target levels for dissolves and fades that may be in progress.

Emulation parameter

The **emulation** parameter returns the state of VGA emulation of CGA and EGA graphics versus VGA native mode. In some graphics modes, CGA and EGA graphics displayed with a CGA or EGA adapter have different horizontal registration relative to video compared to graphics with the same mode number displayed with a VGA adapter. Implementations that support CGA or EGA graphics only always return one (on). (See Appendix A for more information on VGA emulation of CGA and EGA graphics.)

vmGetState

Gmode parameter The **gmode** parameter returns the current video mode exactly as it would be returned by a request to BIOS interrupt 10H, service 0FH (see Appendix B).

Horzpix and vertpix parameters The **horzpix** and **vertpix** parameters return the current pixel resolution. These parameters are especially useful for determining the resolution of text modes where the number of pixels displayed on the screen varies from one graphics device to another (CGA, EGA, MCGA, VGA).

Logcolors and physcolors parameters The **logcolors** parameter returns the number of logical colors (simultaneously displayable colors) that are available. The **physcolors** parameter returns the range of colors (palette size) that can be assigned to logical colors. Both return values are determined by the capabilities of the graphics hardware and mode.

Transcolors parameter The **transcolors** parameter returns the total number of logical colors that can be made transparent with **vmSetTrans**.

Tsources parameter The **tsources** parameter returns the total number of video sources for which VDI Management was installed.

Vmode parameter The **vmode** parameter returns the video mode as set by **vmSetVideo**. The **vmode** is either 0 (native), 1 (NTSC), or 2 (PAL). Native mode is a nonoverlay mode, but does not change overlay parameters. NTSC and PAL indicate the system is configured for the indicated video standard.

Width parameter The **width** parameter returns the total graphics width in microseconds. This parameter lets applications accurately establish the right edge of the active graphics area relative to background video. (See Appendix A for more information on graphics registration.)

> **Width** is an extended parameter. Using an unimplemented extended parameter causes error 48 (Unknown parameter).

vmGetState

Xoffset and yoffset parameters

The **xoffset** and **yoffset** give the offset of the graphics plane relative to the video plane in pixels as set by **vmSetGraphics**. The origin of the graphics plane is the upper left corner of the graphics display area.

Parameters resulting in errors

If a parameter causes an error, **vmGetState** returns immediately with an error message. The command does not return partial responses for other parameters that do not cause errors.

Notes

1. Trying to queue **vmGetState** causes error 177 (Command cannot be queued) at the time of the attempt.

Returns

ASCII

On success: Comma-separated list of values for requested parameters as described above.

On failure: "ERROR n...".

Binary

On success: AX = 0. Values associated with requested parameters are 32-bit values of the types given in the binary parameter table above.

On failure: AX = error number. Any return values in the parameter block addressed by ES:DI are undefined and should be ignored.

See also:

syGetState, syQueue, vdGetState, vmFade, vmGetPalette, vmInit, vmSetGraphics, vmSetVideo, vmSetTrans, xyGetState.

Examples

ASCII

Get the current graphics level and mode

```
vmGetState glevel,gmode
  (returns) "0,14"        ; graphics level currently set to 0
                          ; graphics mode is 14 (640 X 200)
```

Determine whether logical color three is transparent

```
vmGetState color=3
  (returns) "1"           ; color number 3 is set for transparency
```

vmGetState

Binary

Get current graphics level, graphics mode, and number of available physical colors

```
AX          2054          ; vmGetState decimal ID
BX          3             ; number of parameters
ES:DI[0]    26            ; glevel decimal ID
ES:DI[4]    any value     ; place holder for value on return
ES:DI[8]    27            ; gmode decimal ID
ES:DI[C]    any value     ; place holder for value on return
ES:DI[10]   36            ; physcolors decimal ID
ES:DI[14]   any value     ; place holder for value on return
```

After return

```
AX          0                   ; returns 0 if successful (nonzero if not)
ES:DI[4]    level value         ; contains current graphics level
ES:DI[C]    gmode value         ; contains current graphics mode number
ES:DI[14]   physcolors value    ; contains available physical colors
```

vmInit

Last revision: R 1.0

Type: core

Parameters

ASCII No parameters.

Binary

Command code: 2055 decimal.

No parameters.

Description

Summary **vmInit** initializes the visual management hardware and software, placing both in a known state.

Conditions set by vmInit **vmInit** sets the parameters in the following table to the specified values.

Parameter values set by vmInit		
Parameter	**Value**	**Command reference**
dlevel	255 (hard keying)	vmFade
emulation	1 (on)	vmSetGraphics
enable	0 (off)	vmSetTrans
glevel	255 (full intensity)	vmFade
gmode	Current value	vmSetGraphics
horzpix	Current value	None
logcolors	System limit for gmode	None
physcolors	System limit for gmode	None
state	0 (transparency off)	vmSetTrans
transcolors	System limit for gmode	None
width[1]	System default for gmode	vmSetGraphics
vertpix	Current value	None
vlevel	0 (off)	vmFade
vmode	0 (native)	vmSetVideo
xoffset	0	vmSetGraphics
yoffset	0	vmSetGraphics

[1] If supported.

vmInit

Notes

1. In typical VDI Management implementations, **vmInit** turns mode trapping on to intercept video BIOS interrupt 10H calls so that applications cannot make graphics mode changes without VDI Management's knowledge. This is especially important for applications that use graphics libraries and similar tool kits. If **vmInit** turns mode trapping on, **syStop** should turn it off.
2. The default **defsource** is video source zero. However, if an application uses **vmSetVideo defsource** to change the source, a subsequent **vmInit** *does not* reset the source to zero and any applicable parameters affect the source set by **vmSetVideo**.
3. Trying to queue **vmInit** causes error 177 (Command cannot be queued) at the time of the attempt.

Returns

ASCII

On success: "OK".

On failure: "ERROR n...".

Binary

On success: AX = 0.

On failure: AX = error number.

See also:

syInit, syStop, vdInit, xyInit.

Examples

ASCII

Initialize visual management services

```
vmInit
  (returns) "OK"
```

Binary examples

Initialize visual management services

```
AX      2055    ; vmInit decimal ID
BX      0       ; number of parameters
```

After return

```
AX      0       ; returns 0 if successful (nonzero if not)
```

vmSetGraphics

Emulation parameter

The **emulation** parameter controls VGA emulation of CGA and EGA horizontal graphics positioning in common modes. If **emulation=1**, the default set by **vmInit**, then a VGA adapter will leave the same borders on the right and left edges of active graphics that a true CGA or EGA adapter would leave. If **emulation=0**, then the graphics from a VGA adapter cover the entire width of the background video. (See Appendix A for more information on graphics registration and VGA emulation of CGA and EGA graphics.)

Issuing **vmSetGraphics emulation=0** on a true CGA or EGA-based system returns error 194 (Unsupported graphics mode).

Gmode parameter

The **gmode** parameter sets the graphics display mode in accordance with IBM graphics mode numbers as returned by BIOS interrupt 10H, service 0FH (see Appendix B). This parameter places mode changes under VDI Management control to keep screen disruption to a minimum (as opposed to using mode functions furnished separately with development systems).

Requesting an unsupported graphics mode returns error 194 (Unsupported graphics mode).

Width parameter

The **width** parameter sets the total graphics width in microseconds. This parameter lets applications accurately establish the right-hand edge of the active graphics area relative to background video. An application would typically display a videodisc position-reference frame for interactively setting **width**. (See Appendix A for more information on graphics registration.)

> **Width** is an extended parameter. Using an unimplemented extended parameter causes error 48 (Unknown parameter).

Xoffset and yoffset parameters

The **xoffset** and **yoffset** parameters set the offset of the upper left corner of the graphics display area relative to video. These parameters shift the entire graphics display area up, down, left, and right within the video raster in one-pixel increments. Positive values shift down and right; negative values shift up and left. (See Appendix A for default offsets by graphics mode.)

Offset values are absolute, not cumulative. Issuing **vmSetGraphics yoffset=4** twice results in an offset of four, not eight. Values that exceed the maximum that a system can shift the graphics plane result in the maximum possible shift.

The offset values set by **vmSetGraphics** remain in effect until explicitly reset by **vmSetGraphics** or **vmInit**. They do not change to compensate for graphics mode changes. Therefore, apparent offsets may change with graphics mode changes because of differences in pixel sizes among modes.

vmSetGraphics

Notes

1. **vmGetState** returns the current X and Y offsets. These values will not agree with the values set by **vmSetGraphics** if the specified values exceed the maximum amount the system can shift the graphics plane.
2. The **xoffset** and **yoffset** parameters are for correcting graphics registration to video. Applications should not use them for special effects such as scrolling the screen because they may cause screen disturbances.

Returns

ASCII

On success: "OK".

On failure: "ERROR n...".

Binary

On success: AX = 0.

On failure: AX = error number.

See also:

vmGetState, vmInit.

Examples

ASCII

Set X and Y offsets to -1 and 5

```
vmSetGraphics xoffset=-1,yoffset=5
  (returns) "OK"
```

Set graphics mode 16 (EGA 640x350)

```
vmSetGraphics gmode=16
  (returns) "OK"
```

Binary

Shift graphics right one and down two

```
AX        2062    ; vmSetGraphics decimal ID
BX        2       ; number of parameters
ES:DI[0]  60      ; xoffset decimal ID
ES:DI[4]  1       ; pixel offset value
ES:DI[8]  66      ; yoffset decimal ID
ES:DI[C]  2       ; pixel offset value
```

After return

```
AX        0       ; returns 0 if successful (nonzero if not)
```

vmSetPalette

Last revision: R 1.0

Type: *core*

Parameters

ASCII

Parameter	Core or extended	Associated calling value	Type as ASCII	Associated return value	Type as ASCII	Default if parameter not used
color	Core	Logical color number	Integer	None	N/A	Causes error
r	Core	Red value, 0–255	Integer	None	N/A	No action
g	Core	Green value, 0–255	Integer	None	N/A	No action
b	Core	Blue value, 0–255	Integer	None	N/A	No action
Exactly one **color** *and at least one of* **r**, **g**, *and* **b** *are required or an error is returned.*						

Binary

Command code: 2063 decimal.

Parameter	Core or extended	Token number (decimal)	Type	Associated calling value	Associated return value	Default if parameter not used
color	Core	9	Integer	Logical color number	None	Causes error
r	Core	38	Integer	Red value, 0–255	None	No action
g	Core	25	Integer	Green value, 0–255	None	No action
b	Core	4	Integer	Blue value, 0–255	None	No action
length	Core	31	Integer	Number of color array entries[1]	None	No action
array	Core	1	Pointer	Pointer to color array	None	No action
Either exactly one **color** and at least one of **r**, **g**, and **b** are required; or **color**, **length**, and **array** must be used together without **r**, **g**, or **b**; or an error is returned.						

[1]color array entry = 4 bytes comprised of 3 components + reserved byte.

vmSetPalette

Description

Summary

vmSetPalette assigns red, green, and blue component values to the specified logical color via the ASCII interface or to one or more contiguous logical colors via the binary interface.

General discussion

vmSetPalette sets the proportions of the red, green, and blue components in a logical color as real numbers in the range 0–255 where 255 is fully saturated. Component values are set for single colors via the ASCII interface and for single or multiple colors via the binary interface depending on the calling parameters.

vmGetState logcolors returns the number of available logical colors (colors that can be simultaneously displayed) for a system and **vmGetState physcolors** returns the number of available physical colors (palette size). *vmSetPalette assigns physical colors* to logical colors and **vmGetPalette** returns the component values for the assigned colors. For example, a system might support 16 logical colors from a palette of 4096 physical colors. Logical color 3 might be bright cyan with component values of **r=0, b=255, g=255**.

Color + r, g, and b parameters

These parameters apply to both the ASCII and binary interfaces. The **color** parameter defines the logical color number for which **r**, **g**, and **b** component values are set. Logical color numbers range from zero to the value returned by **vmGetState logcolors** minus one.

VDI Management maps the specified component levels to the color as closely as possible given the size of the available palette. For example, if the palette furnishes four color levels (0, 85, 170, and 255) for each component (64-color palette), **vmSetPalette color=1,r=110** results in a mapped value of **r=85**.

Exactly one **color** parameter must be listed. Specifying **color** twice causes error 54 (Parameter used more than once) while omitting **color** entirely or failing to include at least one of **r**, **g**, and **b** causes error 49 (Insufficient parameters). Any or all of **r**, **g**, and **b** can be specified in the same call.

vmSetPalette

Color + length and array parameters

The **length** and **array** parameters are available with the binary interface only. They provide a way to pass a pointer to an array for storing a set of palette values in application memory. The value associated with **array** is a 32-bit pointer to a memory block containing one or more 4-byte structures. **Array** must point to memory allocated by the application. The contents of each structure in the palette array are:

- Byte 0, the least significant byte, represents blue.
- Byte 1 represents green.
- Byte 2 represents red.
- Byte 3 is reserved and **must** be set to zero.

The **length** parameter specifies the number of 4-byte structures in the array. The values in the first structure of the array are for the logical color specified by the **color** parameter. The second structure relates to **color+1**, the third to **color+2**, an so on up to the number of structures specified by **length**. (See Section 4.4.2 for more information about color arrays.)

Using the **length** and **array** with any of **r**, **g**, or **b** causes error 50 (Parameters cannot be used together).

Notes

1. Use **syQueue** to set multiple logical colors in the same vertical interval via the ASCII interface.
2. Component values returned by **vmGetPalette** may not agree exactly with values set by **vmSetPalette** because of rounding. For example, a system with 4 levels per component (0, 85, 170, 255) will return a component value of 85 even though the value specified by **vmSetPalette** was 55.
3. VDI Management does not maintain palette arrays that are directly accessible by applications. Palette arrays for **vmSetPalette** must be allocated by the application. To allocate memory in bytes for a palette array, use **length** × 4.
4. If a **vmSetPalette** is used with palette array and queued with **syQueue**, do not deallocate the array before executing the queue.

Returns

ASCII

On success: "OK".

On failure: "ERROR n...".

Binary

On success: AX = 0.

On failure: AX = error number.

vmSetPalette

See also: syQueue, vmGetPalette, vmGetState.

Examples

ASCII

Set red to 63 for color 0, do not change other components

```
vmSetPalette color=0,r=63
   (returns) "OK"
```

Set color 1 to pure fully saturated blue

```
vmSetPalette color=1,r=0,g=0,b=255
   (returns) "OK"
```

Set color 2 to *bright white*

```
vmSetPalette color=2,r=255,g=255,b=255
   (returns) "OK"
```

Binary

Set green to 127 for color 3, do not change other components

```
AX          2063        ; vmSetPalette decimal ID
BX          2           ; number of parameters
ES:DI[0]    9           ; color decimal ID
ES:DI[4]    3           ; color number
ES:DI[8]    25          ; g decimal ID
ES:DI[C]    127         ; green value
```

After return

```
AX          0           ; returns 0 if successful (nonzero if not)
```

Set component values for colors 3–9

```
AX          2063        ; vmSetPalette decimal ID
BX          3           ; number of parameters
ES:DI[0]    9           ; color decimal ID
ES:DI[4]    3           ; first color of array list
ES:DI[8]    31          ; length decimal ID
ES:DI[C]    7           ; number of color structures in palette array
ES:DI[10]   1           ; array decimal ID
ES:DI[14]   pointer     ; pointer to palette array in application memory
```

After return

```
AX          0           ; returns 0 if successful (nonzero if not)
```

vmSetTrans

Last revision: R 1.0

Type: core

Parameters

ASCII

Parameter	Core or extended	Associated calling value	Type as ASCII	Associated return value	Type as ASCII	Default if parameter not used
clear	Core	None	N/A	None	N/A	No action
color	Core	Logical color number	Integer	None	N/A	No action
enable	Core	1 (on) | 0 (off)	Integer	None	N/A	No action
state	Core	1 (on) | 0 (off)	Integer	None	N/A	No action
Either both **color** and **state**, or **clear** only must be used or an error is returned. **Enable** can be used alone or with a **color** + **state**.						

Binary

Command code: 2064 decimal.

Parameter	Core or extended	Token number (decimal)	Type	Associated calling value	Associated return value	Default if parameter not used
clear	Core	8	N/A	None	None	No action
color	Core	9	Integer	Logical color number	None	No action
enable	Core	20	Integer	1 (on) | 0 (off)	None	No action
state	Core	42	Integer	1 (on) | 0 (off)	None	No action
Either both **color** and **state**, or **clear** only must be used or an error is returned. **Enable** can be used alone or with a **color** + **state**.						

Description

Summary

vmSetTrans sets logical colors to transparent or opaque and turns physical transparency on and off.

Clear

The **clear** parameter sets the transparency state of **all** logical colors to zero (off). Note that this not only turns transparency off but also changes the values of color attributes. Use the **enable** parameter (see below) to turn transparency off without changing the transparency settings of the colors.

vmSetTrans

Using **vmSetTrans clear** when no transparent colors are set does nothing and is not an error. Using **clear** with any other parameter returns error 50 (Parameters cannot be used together).

Color and state parameters

The **color** and **state** parameters work together to set logical colors to opaque or transparent. **vmSetTrans color=(logical color number), state=1** makes colors transparent; **vmSetTrans color=(logical color number), state=0** makes colors opaque. To temporarily override transparent colors, use the **enable** parameter (see below).

Enable parameter

The **enable** parameter controls physical transparency on the display screen. **vmSetTrans enable=1** makes all designated transparent colors actually become transparent to the video plane. Areas containing transparent colors on the screen show the video plane only.

vmSetTrans enable=0 makes all colors physically opaque regardless of their transparency settings. None of the video plane is visible. However, transparent colors keep their transparency settings and will again be physically transparent after a subsequent **vmSetTrans enable=1**.

Enable can be combined with a **color** and a **state** to specify a transparent color and turn transparency on with the same command. The default for **enable** after a **vmInit** is zero (transparency off).

Notes

1. **vmGetState logcolors** returns the total number of available logical colors. **vmGetState color** returns the transparency setting for a single specified color.
2. **vmGetState transcolors** returns the number of logical colors that can be made transparent. Using **vmSetTrans** to try to set more than **transcolors** to transparent returns error 51 (Parameter invalid or out of range).

Compliant systems must support transparency for at least one color that can be assigned to any logical color. Applications striving for maximum portability should not assume more than one transparent color.

vmSetTrans

Returns

ASCII

On success: "OK".

On failure: "ERROR n...".

Binary

On success: AX = 0.

On failure: AX = error number.

See also:

vmGetState.

Examples

ASCII

Set color 0 to transparent and enable physical transparency

vmSetTrans color=0,state=1,enable=1
(returns) "OK"

Set color 5 to opaque

vmSetTrans color=5,state=0
(returns) "OK"

Set all colors to opaque

vmSetTrans clear
(returns) "OK"

Binary

Designate color 3 as transparent and make it physically transparent

```
AX          2064        ; vmSetTrans decimal ID
BX          3           ; number of parameters
ES:DI[0]    9           ; color decimal ID
ES:DI[4]    3           ; color number
ES:DI[8]    42          ; state decimal ID
ES:DI[C]    1           ; make color 3 transparent
ES:DI[10]   20          ; enable decimal idea
ES:DI[14]   1           ; turn physical transparency on
```

After return

```
AX          0           ; returns 0 if successful (nonzero if not)
```

Make all colors opaque

```
AX          2064        ; vmSetTrans decimal ID
BX          1           ; number of parameters
ES:DI[0]    8           ; clear decimal ID
ES:DI[4]    any value
```

After return

```
AX          0           ; returns 0 if successful (nonzero if not)
```

vmSetVideo

Current: R 1.0

Type: core

Parameters

ASCII

Parameter	Core or extended	Associated calling value	Type as ASCII	Associated return value	Type as ASCII	Default if parameter not used
defsource	Core	Input source, 0–15	Integer	None	N/A	No action
vmode	Core	0 (native) | 1 (NTSC) | 2 (PAL)	Integer	None	N/A	No action
At least one parameter is required or an error is returned.						

Binary

Command code: 2065 decimal.

Parameter	Core or extended	Token number (decimal)	Type	Associated calling value	Associated return value	Default if parameter not used
defsource	Core	13	Integer	Input source, 0–15	None	No action
vmode	Core	53	Integer	0 (native) | 1 (NTSC) | 2 (PAL)	None	No action
At least one parameter is required or an error is returned.						

Description

Summary

vmSetVideo sets the video mode and selects the video input source if more than one source is available.

Defsource parameter

The **defsource** parameter selects a video input source in the range 0 to 15 when more than one video source is available. The default at start-up is source zero.

Vmode parameter

The **vmode** parameter tells the visual-management system which video standard incoming video and the monitor are using. This lets VDI Management use the appropriate timing values for the standard. **Vmode=1** sets NTSC-U.S.; **vmode=2** sets PAL-European. **vmSetVideo vmode=0** (native) sets the system to the functionality and appearance that the computer would use if it were not an IV system. This setting also turns overlay off without affecting any other parameters relating to overlay.

vmSetVideo

vmSetVideo vmode... may cause screen disturbances because of the asynchronous rates of the graphics and video signals.

Notes

1. A video source is always selected, but the source number will not necessarily equal the current default player number. For example, logical player zero may be logical video source one. This mapping is done at VDI installation/configuration time. (See Section 4.1.2 for more information.)
2. After a player is selected with **vdSet defdevice** (see Section 8), it must be activated as a video source with **vmSetVideo defsource**.

Returns

ASCII

On success: "OK".

On failure: "ERROR n...".

Binary

On success: AX = 0.

On failure: AX = error number.

See also:

vdSet, vmGetState.

Examples

ASCII

Set the standard to NTSC

```
vmSetVideo vmode=1
  (returns) "OK"
```

Make video source one the default

```
vmSetVideo defsource=1
  (returns) "OK"
```

Binary

Set mode to NTSC

```
AX          2065        ; vmSetVideo decimal command ID
BX          1           ; number of parameters
ES:DI[0]    53          ; vmode decimal ID
ES:DI[4]    1           ; sets mode to NTSC (1)
```

After return

```
AX          0           ; returns 0 if successful (nonzero if not)
```

8 Videodisc commands (vd)

This section describes commands that control videodisc players. Use these commands to initialize, obtain information about, and control the behavior of videodisc players connected to the system. Table 8–1 lists the commands covered in this section, their token numbers, and their types.

Table 8–1. Videodisc command names, token numbers, and types

ASCII command name[1]	Binary interface token number (decimal)	Type[2]
vdGetState	3078	Core
vdInit	3079	Core
vdPassThru	3080	Core
vdPlay	3081	Core
vdScan	3083	Core
vdSearch	3084	Core
vdSet	3085	Core
vdStep	3090	Core
vdStill	3091	Core

[1]Upper or lower case for command names is not significant.
[2]Compliant implementations must support "Core" commands.

8.1 General information and assumptions

The general information and assumptions given in this subsection were used in the definition of the videodisc commands.

8.1.1 CAV and CLV videodisc support

Current technology uses two types of videodiscs—constant angular velocity (CAV) and constant liner velocity (CLV). These vary in the information supplied on the videodisc and the way in which they are read. The individual

command descriptions indicate commands and parameters that apply to CLV videodiscs only.

Current support for CLV videodiscs is a subset of CAV functions. We do not rule out adding extended commands and parameters to provide more sophisticated CLV support in future revisions of this document.

Compliant players must support both CAV and CLV videodiscs.

8.1.2 Play and scan speeds

Play speeds are expressed as a multiples of 1.0, which is defined as the normal speed of either 25 frames per second for PAL or 30 frames per second for NTSC. For players in CAV mode, applications can assume that speed 1.0, at least one speed slower than 1.0, and at least one speed faster than 1.0 are available. For players in CLV mode, applications cannot assume play speeds other than 1.0. (Section 8.2 explains how VDI Managements round speeds when requested speeds cannot be matched exactly by a player.)

Scan speeds vary among players. All an application can assume about a scan *speed is that it is faster than normal speed.*

Note: Because applications cannot assume that values other than 1.0 will be matched exactly, they should not try to calculate videodisc position based on timing and frame speed at any speed other than 1.0. Instead, they should use **vdGetState frame** (see **vdGetState** command).

8.1.3 Searches and instant jumps

When searching for a specific frame or chapter, players should use instant jumps if possible. If not, the search should always be at the fastest possible speed. Blanking during searches is automatic and, therefore, is not under VDI Management control.

8.1.4 Fields, frames, and chapters

All frame numbers assume a standard format of two fields per frame. The command set does not support accessing individual fields. The command set assumes that frame numbers are always available from CAV and never from CLV and that chapter numbers may be available from either.

8.2 Rounding methods for player speeds

Player speeds are represented by real numbers, with 1.0 representing normal speed. Values below 1.0 represent speeds below normal; values above 1.0 represent speeds above normal. A value other than 1.0 calls for a speed in frames per second (fps) that equals the product of the value and the default number of frames per second. For example, on an NTSC system, a speed of 0.5 specifies a rate of 0.5 × 30 fps or 15 fps.

Videodisc players are usually limited to a finite range of speeds. If a requested speed is not 1.0, VDI Management uses a rounding algorithm to translate from the specified speed to a player-supported speed. The algorithm rounds to the nearest supported speed, except that *values are never rounded to 0.0 or 1.0* except for players in CLV mode (see below). This method lets applications guarantee use of the fastest fast and slowest slow speeds available. The following tables show how speeds are rounded for the Sony 2000 and Pioneer 4200, respectively. Note that speed requests of 0.0 are errors.

Table 8–2. The effects of rounding on speed parameters for the Sony 2000

Requested speed	Actual speed as multiple of normal
0.0	Error
0.00001–0.99999	0.2
1.0	1.0
1.00001 and up	3

Table 8–3. The effects of rounding on speed parameters for the Pioneer 4200

Requested speed	Actual speed as multiple of normal
0.0	Error
0.00001–0.14999	0.1
0.15–0.34999	0.2
0.35–0.64999	0.5
0.65–0.99999	0.8
1.0	1
1.0001–2.4999	2
2.5–3.4999	3
3.5 and up	4

For players in CAV mode, applications can assume that normal speed, 1.0, at least one speed slower than 1.0, and at least one speed faster than 1.0 are

available. Given this availability and the rounding algorithm, which never rounds to 0.0 or 1.0, the following table lists speed parameter values for specifying several convenient speeds without knowing the exact speeds available from a given player.

Table 8–4. Example speed parameter values for boundary player speeds

Speed parameter value	Resulting player speed
0.0	Error
0.00001	Slowest available speed
0.99999	Fastest speed that is slower than normal
1.00001	Slowest speed that is faster than normal
9999	Fastest available speed

For players in CLV mode, applications cannot assume play speeds other than normal speed. For players that support normal speed only, all speeds other than zero are rounded to one. However, if the player supports multiple speeds in CLV mode, VDI Management applies normal rounding rules.

Note: After requesting a play speed, a query for that speed returns the actual speed if it differs from the requested speed because of rounding.

vdGetState

Last revision: R 1.0

Type: core

Parameters

ASCII

Parameter	Core or extended	Associated calling value	Type as ASCII	Associated return value	Type as ASCII	Default if parameter not used
audio1	Core	None	N/A	1 (on) | 0 (off)	Integer	No action
audio2	Core	None	N/A	1 (on) | 0 (off)	Integer	No action
cdisplay	Core	None	N/A	1 (on) | 0 (off)	Integer	No action
chapter	Core	None	N/A	Current chapter number	Integer	No action
defdevice	Core	None	N/A	Default player, 0–15	Integer	No action
device	Core	Logical player, 0–15	Integer	None	N/A	Default player
disctype	Core	None	N/A	1 (CLV) | 0 (CAV)	Integer	No action
door	Extended	None	N/A	1 (open) | 0 (closed)	Integer	No action
frame[1]	Core	None	N/A	Current frame number	Integer	No action
idxdisplay	Core	None	N/A	1 (on) | 0 (off)	Integer	No action
motion	Core	None	N/A	1 (on) | 0 (off)	Integer	No action
remote	Extended	None	N/A	1 (on) | 0 (off)	Integer	No action
speed	Core	None	N/A	Current player speed or 999 if scanning	Real	No action
spin	Core	None	N/A	1 (up) | 0 (down)	Integer	No action
tdevices	Core	None	N/A	Total installed for, 0–15	Integer	No action
video	Core	None	N/A	1 (on) | 0 (off)	Integer	No action
At least one parameter must be specified or an error occurs. If **device** is specified, at least one other parameter must be specified.						

[1]Supported for CAV videodiscs only. All other parameters apply to both CAV and CLV videodiscs.

vdGetState

Binary

Command code: 3078 decimal.

Parameter	Core or extended	Token number (decimal)	Type	Associated calling value	Associated return value	Default if parameter not used
audio1	Core	2	Integer	Any value	1 (on) | 0 (off)	No action
audio2	Core	3	Integer	Any value	1 (on) | 0 (off)	No action
cdisplay	Core	6	Integer	Any value	1 (on) | 0 (off)	No action
chapter	Core	7	Integer	Any value	Current chapter number	No action
defdevice	Core	12	Integer	Any value	Default player, 0–15	No action
device	Core	14	Integer	Logical player, 0–15	None	Default player
disctype	Core	16	Integer	Any value	1 (CLV) | 0 (CAV)	
door	Extended	18	Integer	Any value	1 (open) | 0 (closed)	No action
frame[1]	Core	23	Integer	Any value	Current frame number	No action
idxdisplay	Core	29	Integer	Any value	1 (on) | 0 (off)	No action
motion	Core	35	Integer	Any value	1 (on) | 0 (off)	No action
remote	Extended	39	Integer	Any value	1 (on) | 0 (off)	No action
speed	Core	40	Real	Any value	Current player speed or 999 if scanning	No action
spin	Core	41	Integer	Any value	1 (up) | 0 (down)	No action
tdevices	Core	45	Integer	Any value	Total installed for, 0–15	No action
video	Core	51	Integer	Any value	1 (on) | 0 (off)	No action
At least one parameter must be specified or an error occurs. If **device** is specified, at least one other parameter must be specified.						

[1]Supported for CAV videodiscs only. All other parameters apply to both CAV and CLV videodiscs.

vdGetState

Description

Summary

vdGetState returns information about the videodisc player specified by the device parameter or the default player if no device number is specified.

Audio1 and audio2 parameters

The **audio1** and **audio2** parameters return one if the respective audio channel is on and zero if it is off.

Cdisplay parameter

The **cdisplay** parameter returns one if the player's chapter number display is on and zero if it is not. Using **cdisplay** with videodiscs that do not have chapter numbers returns error 88 (Unable to return requested information).

Chapter parameter

The **chapter** parameter returns the current videodisc chapter number. **vdGetState chapter...** returns error 86 (Device not ready) if the videodisc is not spinning normally and error 88 (Unable to return requested information) *if the videodisc does not have chapter numbers.*

Defdevice parameter

The **defdevice** parameter returns the default logical player number as set by **vdSet defdevice** or vdInit. VDI Management directs all videodisc commands to this player unless a command contains a **device** parameter (see below) directing it to a different player.

Device parameter

The **device** parameter directs **vdGetState** to the specified logical player number regardless of the current player number as set by **vdSet defdevice**. Because, in general, **device** affects the command with which it is associated only, the parameter does not affect the return value for **defdevice** (see above) when the two parameters are used together.

Specifying **device** with no other parameter returns error 49 (Insufficient parameters). Specifying a nonexistent or uninstalled player returns error 160 (Invalid device number). Specifying an uninitialized player returns error 81 (Device not initialized).

Disctype parameter

The **disctype** parameter returns one if the videodisc is a CLV disc and zero if it is a CAV disc.

vdGetState

Door parameter

The **door** parameter returns one if the player door is open and zero if it is closed. VDI implementers should implement **door** for a player that supports reporting the door's status even if the player does not support opening and closing the door from an application. If an implementation supports the **door** parameter but a player does not support reporting its status, VDI Management returns error 88 (Unable to return requested information).

> **Door** is an extended parameter. Using an unimplemented extended parameter causes error 48 (Unknown parameter).

Frame parameter

The **frame** parameter returns the current frame number of the videodisc player. **vdGetState frame...** returns error 86 (Device not ready) if the videodisc is not spinning normally. **Frame** returns error 88 (Unable to return requested information) for CLV discs.

Idxdisplay parameter

The **idxdisplay** parameter returns one if player's frame number (CAV) or time (CLV) display is on and zero if it is not.

Motion parameter

The **motion** parameter returns the state of a background play or scan. If the laser is reading the videodisc during a play or scan sequence either backward or forward, **motion** returns one; otherwise, it returns zero.

Remote parameter

The **remote** parameter returns one if the player's remote control unit is on and zero if it is off. If a VDI implementation supports the **remote** parameter but the player does not support a remote control unit, **remote** returns zero.

> **Remote** is an extended parameter. Using an unimplemented extended parameter causes error 48 (Unknown parameter).

Speed parameter

The **speed** parameter returns the actual player speed after any necessary rounding or 999 if the player is in scan mode. A return of zero indicates the player is parked or on a still frame. (See Section 8.2 for information on rounding speed values.)

Spin parameter

The **spin** parameter returns zero if the player is parked or one if the videodisc is spinning and the player is ready to accept motion commands.

Tdevices parameter

The **tdevices** parameter returns the total number of logical players for which VDI Management was configured when it was installed. If only one player is connected, it is numbered zero, and **tdevices** returns one.

vdGetState

Video parameter

The **video** parameter returns one if the player's video channel is on and zero if it is not.

Parameters resulting in errors

If a parameter causes an error, **vdGetState** returns immediately with the error message. The command does not return partial responses for other parameters that did not cause errors.

Notes

1. **vdGetState** can be successfully issued any time VDI Management can accept commands. The current state of the player does not affect whether the command can be issued. However, the player's state can affect the ability to return specific parameter values,and therefore cause errors. For example, **vdGetState frame** returns error 88 (Unable to return requested information) if the player is parked.
2. Trying to queue **vdGetState** causes error 177 (Command cannot be queued) at the time of the attempt.

Returns

ASCII

On success: Comma-separated list of values for requested parameters as described above.

On failure: "ERROR n...".

Binary

On success: AX = 0. Values associated with requested parameters are 32-bit values of the types given in the binary parameter table above.

On failure: AX = error number. Any return values in the parameter block addressed by ES:DI are undefined and should be ignored.

See also:

syGetState, vdInit, vdSet, vmGetState, xyGetState.

Examples

ASCII

Get status of player 2 motion flag

```
vdGetState device=2,motion
  (returns) "1"          ; player 2 is in play or scan mode
```

Get information on door and spin state for current player

```
vdGetState door,spin
  (returns) "1,0"        ; door is open and player is spun down
```

vdGetState

Get whether disc index display is on for current player

```
vdGetstate idxdisplay
  (returns) "1"          ; videodisc index display is on
```

Get whether player 1 video is on and currently selected player

```
vdGetState device=1,video,defdevice
  (returns) "1,2"        ; player 1 video is on,
                         ; default player is logical number 2
```

Binary

Get status of motion flag

```
AX          3078         ; vdGetstate decimal ID
BX          1            ; number of parameters
ES:DI[0]    35           ; motion decimal ID
ES:DI[4]    any value    ; place holder for motion value after return
```

After return

```
AX          0            ; returns 0 if successful (nonzero if not)
ES:DI[4]    1            ; value for motion, player is playing or scanning
```

vdInit

Last Revision: R 1.0

Type: core

Parameters

ASCII

Parameter	Core or extended	Associated calling value	Type as ASCII	Associated return value	Type as ASCII	Default if parameter not used
device[1]	Core	Logical player, 0–15	Integer	None	N/A	Default player
This command can be issued with no parameters.						

[1]This parameter applies to both CAV and CLV videodiscs as does vdInit with no parameters.

Binary

Command code: 3079 decimal.

Parameter	Core or extended	Token number (decimal)	Type	Associated calling value	Associated return value	Default if parameter not used
device[1]	Core	14	Integer	Logical player, 0–15	None	Default player
This command can be issued with no parameters.						

[1]This parameter applies to both CAV and CLV videodiscs as does vdInit with no parameters.

Description

Summary

vdInit initializes videodisc hardware and the **vd** software service group, placing both in a known state. **vdInit** *must* be issued for each attached player that will be used by the application. This command interrupts any other player motion command that did not include a **wait** parameter, in which case, the application will not be able to issue **vdInit** until the motion command is complete.

vdInit is a synchronous command. It does not return control to the application until it has succeeded or detected an error condition. To keep disturbances to a minimum, VDI Management should turn video and audio off at the player, spin up the videodisc, then turn video and audio back on.

vdInit

The resulting display after **vdInit** varies with videodisc type. With CAV videodiscs, video remains visible with the player frozen on the first available frame. With most CLV videodiscs, the player automatically blanks video.

Device parameter

The **device** parameter specifies the logical player number to be initialized. If **device** is omitted, **vdInit** initializes the default player as set by **vdSet defdevice**. If **vdSet** has not been used to set a default player, the default player is defined to be number zero. **vdInit** does not change the default player if a **device** other than the default is specified. To change the default, use **vdSet defdevice**.

Specifying a nonexistent or uninstalled player causes error 160 (Invalid device number).

Conditions set by vdInit

vdInit sets the parameters in the following table to the specified values.

Parameter values set by vdInit		
Parameter	**Value**	**Command reference**
audio1	1 (on)	vdSet
audio2	1 (on)	vdSet
cdisplay	0 (off) or undefined	vdSet
door[1]	0 (closed)	vdSet
frame	First available on disc	vdPlay, vdSet
idxdisplay	0 (off)	vdSet
motion	0 (off)	vdGetState
remote[1]	0 (off)	vdSet
spin	1 (up)	vdSet
tdevices	Total installed, 0–15	none
video	1 (on)	vdSet

[1] If supported by implementation—this is an extended parameter.

Notes

1. **vdInit** can be successfully issued any time the specified **device** or, without a specified **device**, the default player, either player zero or the player set by **vdSet defdevice**, can accept motion commands (except see Note 4 below).

2. **vdGetState tdevices** returns the total number of players for which VDI Management was installed. This command can be used after the first **vdInit** to determine the number of additional devices that can be initialized.

3. If the player supports a character generator, **vdInit** turns it off.

vdInit

4. Trying to queue **vdInit** causes error 177 (Command cannot be queued) at the time of the attempt.

5. With systems that do not support the **door** parameter, VDI Management returns error 80 (Initialization error) if an application issues **vdInit** with the player door open. Therefore, it is good programming practice to prompt the user to insert the videodisc and close the door before issuing **vdInit**.

6. Spinning the videodisc up also updates the **disctype** parameter, and sets **cdisplay** to undefined for videodiscs that do not support chapter numbers.

7. If **vdInit** returns an error, the parameters listed in the table above have undefined values.

Returns

ASCII

On success: "OK".

On failure: "*ERROR* n...".

Binary

On success: AX = 0.

On failure: AX = error number.

See also:

syInit, vdGetstate, vdSet, vmInit, xyInit.

Examples

ASCII

Initialize player 0 and vd service group

```
vdInit
  (returns) "OK"        ; first time command is issued
```

Initialize player 1

```
vdInit device=1
  (returns) "OK"
```

vdInit

Binary

Initialize player 0 and vd service group	AX	3079	; **vdInit** decimal ID
	BX	0	; number of parameters
After return	AX	0	; returns 0 if successful (nonzero if not)
Initialize player 1	AX	3079	; **vdInit** decimal ID
	BX	1	; number of parameters
	ES:DI[0]	14	; **device** decimal ID
	ES:DI[4]	1	; logical player number for **device**
After return	AX	0	; returns 0 if successful (nonzero if not)

vdPassThru

Last revision: R 1.0

Type: core

Parameters

ASCII

No named parameters (see discussion of **device** and **pmsg** parameters below). Applies to both CAV and CLV videodiscs.

Binary

Command code: 3080 decimal.

Parameter[1]	Core or extended	Token number (decimal)	Type	Associated calling value	Associated return value	Default if parameter not used
device	Core	14	Integer	Logical player, 0–15	None	Default player
pmsg	Core	37	Pointer	Pointer to player message string	Player response string	Causes error
This command must be issued with the **pmsg** parameter or an error is returned.						

[1] All parameters apply to both CAV and CLV videodiscs.

Description

Caution

vdPassThru is provided to allow nonportable access to special features of videodisc players. It is included to as a convenience to developers who want to use the command set for portable applications and do not want to switch to a different command environment for development efforts that require access to nonportable player functions that are not provided by other commands in the videodisc service group. Therefore, although it is required, it is supplied for convenience only and SHOULD NOT be used for developing portable applications.

Summary

vdPassThru communicates directly with a player, bypassing the standard videodisc service group commands and parameters. It is provided to allow access to specific player features that are not supported by other VDI videodisc commands. **vdPassThru** passes an string of printable ASCII characters to the player and waits for the player's response. This response is returned to the application. **vdPassThru** does not return application control until it receives a response from the player or detects an error.

vdPassThru

Device parameter

The **device** parameter directs **vdPassThru** to the specified logical player number regardless of the default player number as set by **vdSet defdevice**. This parameter applies to the binary interface only.

Specifying a nonexistent or uninstalled player causes error 160 (Invalid device number). Specifying an uninitialized player causes error 81 (Device not initialized).

The ASCII interface does not accept a **device** parameter because of potential difficulties in distinguishing the parameter label and associated value from the string that should be passed to the player. Therefore, the ASCII interface always sends the command string to the default player. (To set the default player, see the **vdSet** command.)

Pmsg parameter

The **pmsg** parameter value is a series of printable ASCII characters to be passed through to the player without modification by VDI Management. However, *implementors may need to implement VDI Management so that it supplies a specific terminator if required by a specific supported player.*

The binary interface passes a pointer to a null-terminated player message string. For the ASCII interface, all characters from the delimiter following the "u" in **vdPassThru** up to the terminating CR make up the message string. The ASCII interface does not use a **pmsg** parameter label.

Returns

ASCII

On success: Player response + CR/LF if CR/LF is not automatically returned by the player.

On failure: "ERROR n...".

Binary

On success: AX = 0. String pointed to by the **pmsg** parameter contains the player response + NULL.

On failure: AX = error number. Any return values in the parameter block addressed by ES:DI are undefined and should be ignored.

Examples

ASCII

Send a string to the player

vdPassThru THIS IS A COMMAND
(returns) "THIS IS A PLAYER RESPONSE"

vdPassThru

Binary

Send a command string to player 2	AX	3080	; **vdPassThru** decimal ID
	BX	2	; number of parameters
	ES:DI[0]	14	; **device** decimal ID
	ES:DI[4]	1	; send message to player 1
	ES:DI[8]	37	; **pmsg** decimal ID
	ES:DI[C]	pointer	; pointer to player message string
After return	AX	0	; returns 0 if successful (nonzero if not)
	ES:DI[C]	pointer	; pointer to player response string

vdPlay

Last revision: R 1.0
Type: core

Parameters

ASCII

Parameter	Core or extended	Associated calling value	Type as ASCII	Associated return value	Type as ASCII	Default if parameter not used
chapter	Core	Chapter number	Integer	None	N/A	No action
device	Core	Logical player, 0–15	Integer	None	N/A	Default player
direction[1]	Core	1 (fwd) | 0 (back)	Integer	None	N/A	1
from[1]	Core	Starting frame number	Integer	None	N/A	Current frame
speed	Core	Play speed, >0	Real	None	N/A	1.0
to[1]	Core	Ending frame number	Integer	None	N/A	Disc limit
wait	Core	None	N/A	None	N/A	No wait
This command may be issued with no parameters. The text describes illegal usage.						

[1]Supported for CAV videodiscs only. All other parameters apply to both CAV and CLV videodiscs as does **vdPlay** with no parameters.

Binary

Command code: 3081 decimal.

Parameter	Core or extended	Token number (decimal)	Type	Associated calling value	Associated return value	Default if parameter not used
chapter	Core	7	Integer	Chapter number	None	No action
device	Core	14	Integer	Logical player, 0–15	None	Default player
direction[1]	Core	15	Integer	1 (fwd) | 0 (back)	None	1
from[1]	Core	24	Integer	Starting frame number	None	Current frame
speed	Core	40	Real	Play speed, >0	Actual speed after rounding if required	1.0
to[1]	Core	48	Integer	Ending frame number	None	Disc limit
wait	Core	54	N/A	None	None	No wait
This command may be issued with no parameters. The text describes illegal usage.						

[1]Supported for CAV videodiscs only. All other parameters apply to both CAV and CLV videodiscs as does **vdPlay** with no parameters.

vdPlay

Description

Summary

vdPlay executes videodisc play sequences. The sequences may include starting frames, ending frames, chapters, directions, and speeds in various combinations. The application can instruct VDI Management to return control immediately or when the play sequence is complete. This command interrupts any other player motion command that did not include a **wait** parameter, in which case, the application will not be able to issue **vdPlay** until the motion command is complete.

No parameters

vdPlay issued with no parameters causes the player to start playing forward from the current frame at a speed of 1.0 and continues until interrupted by a subsequent **vdInit**, **vdPlay**, **vdScan**, **vdSearch**, **vdSet spin=down**, **vdStep**, or **vdStill** command, or until the player reaches the end of the videodisc.

Chapter parameter

The **chapter** parameter specifies a chapter number to play from beginning to end. When used with a **speed** parameter, the chapter plays at the specified speed. Adding **wait** causes VDI Management to wait to return application control until the chapter has been played.

Specifying a **chapter** for a videodisc without chapter numbers causes error 208, (Action not supported by disc). Specifying an illegal chapter number causes error 216 (Invalid chapter number).

Compatible parameters—device, speed, and **wait.** Other parameters cause error 50 (Parameters cannot be used together).

Device parameter

The **device** parameter directs **vdPlay** to the specified logical player number regardless of the default player number as set by **vdSet defdevice.** Specifying a nonexistent or uninstalled player causes error 160 (Invalid device number); specifying an uninitialized player causes error 81 (Device not initialized).

Compatible parameters—all, assuming other parameters are compatible with each other.

Direction parameter

The **direction** parameter sets the direction of motion (1 = forward, 0 = backward) for play sequences that **do not** include **to** frames. Specifying a **direction** with no **from** frame or **chapter** starts a play sequence in the specified **direction** from the current frame at an optional **speed.** If a **from** frame is specified, the player searches to the specified frame, then begins play in the specified **direction.** Specifying a **direction** with a **chapter** is discussed above (see the **chapter** parameter above).

vdPlay

Specifying a **direction** with a **to** frame causes error 50 (Parameters cannot be used together) because the direction required to reach the **to** frame is predetermined either by the relative position of the current frame or, if specified, the relative position of the **from** frame. Therefore, a **direction** used with a **to** frame is at best redundant if it agrees with the predetermined direction, and at worst conflicting if it opposes the predetermined direction.

Compatible parameters—from, device, speed, and **wait.** Other parameters cause error 50 (Parameters cannot be used together).

From parameter

The **from** parameter specifies the starting frame number for a play sequence. The player immediately searches or jumps to the specified frame with video off, turns video on, and executes the play sequence at an optional **speed** and either to an optional **to** frame *OR* in an optional **direction.** Note that **vdPlay from=1000, to=1000** is exactly the same as **vdSearch frame=1000.**

A **from** parameter with no **to** parameter starts an unbounded play. The play sequence continues until interrupted by another **vdPlay,** or a **vdInit, vdScan, vdSearch, vdSet spin=down, vdStep,** or **vdStill** command, or until the player reaches the edge of the videodisc.

Specifying a **from** frame for a CLV videodisc causes error 208, (Action not supported by disc). Specifying an illegal frame number causes error 215 (Invalid frame number).

Compatible parameters—device, direction *OR* **to, speed,** and **wait.** Other parameters or illegal combinations of compatible parameters cause error 50 (Parameters cannot be used together).

Speed parameter

The **speed** parameter specifies the speed of play. VDI Management maps requested speeds as closely as possible to available player speeds. Because actual speeds may vary from requested speeds, the binary interface changes the speed value passed in the parameter block to the actual speed set by VDI Management and **vdGetState speed** returns the actual speed after any necessary rounding. For CAV mode, speeds are never rounded to zero or one. (See Section 8.2 for detailed information on rounding speed values including boundary conditions.)

Specifying a speed less than or equal to zero causes error 51 (Parameter value invalid or out of range).

Compatible parameters—device, direction *OR* **to, from, chapter** but not with **from** or **to,** and **wait.** Other parameters or illegal combinations of compatible parameters cause error 50 (Parameters cannot be used together).

vdPlay

To parameter

The **to** parameter specifies the ending frame number for a play sequence. When the player reaches the **to** frame, the player automatically enters still mode displaying the frame.

The **to** parameter has lower priority than the **from** parameter. For example, **vdPlay from=100, to=1000** and **vdPlay to=1000, from=100** both search to frame 100, then play to frame 1000.

Specifying a **to** frame for a CLV videodisc caused error 208, (Action not supported by disc). Specifying an illegal frame number causes error 215 (Invalid frame number). Specifying a **to** frame with a **direction** is covered above (see Direction parameter).

Compatible parameters—device, from, speed, and **wait.** Other parameters cause error 50 (Parameters cannot be used together).

Wait parameter

The effect of the **wait** parameter depends on the parameters that accompany it. The following table lists when **vdPlay wait...** returns application control based on accompanying parameters. Obviously, if the player returns an error, the command will return when the error state is detected instead of at the time given in the table.

Effects of wait on vdPlay	
Additional parameter	**Returns control when?**
none	After the default player is playing normally
chapter	After the player has played the specified **chapter**
device only	After the specified player is playing normally
from with any other legal parameters except **to**	After the player has searched to the specified **from** frame
speed only	After the player is playing normally at the specified **speed**
to with any other legal parameters	After the player reached the specified **to** frame

Without **wait**, VDI Management returns control as soon as it determines that the command is legal. No error checking is done to determine if the player actually accepts the command or acts on it properly. Therefore, **syCheckErr** must be used to determine if the player entered an error state while either accepting or trying to execute the command.

vdPlay

syCheckErr may also be needed to detect certain error states that occur after **vdPlay wait**. For example, **vdPlay wait, from=1000** returns when the **from** frame has been reached. **syCheckErr** is required to detect any error state that occurs after the player has reached frame 1000.

Note that without **wait**, a subsequent **vdPlay, vdInit, vdScan, vdSearch, vdSet spin=down, vdStep** or **vdStill** command immediately interrupts an executing play sequence, even if the play sequence specifies a target—either a **to** frame or the end of a chapter.

Compatible parameters—all, assuming other parameters are compatible with each other.

Notes

1. **vdPlay** can be successfully issued any time **spin=1** (up) as set by **vdSet**.
2. **vdGetState motion** can be used to find out whether the player is currently executing a play sequence. This could be used, for example, with a **vdPlay to...** with no **wait** parameter to determine whether the **to** frame has been reached.
3. All parameters apply to the current **vdPlay** only. For example, **vdPlay to=1000, speed=.5** *does not set the speed to a default of* 0.5. A subsequent **vdPlay** without a **speed** will play at speed 1.0, not 0.5.

Returns

ASCII

On success: "OK".

On failure: "ERROR n...".

Binary

On success: AX = 0. Value associated with **speed** parameter is a 32-bit real that gives the actual speed that will be set after rounding if required.

On failure: AX = error number.

See also:

syCheckErr, vdGetState, vdScan, vdSearch vdStep, vdStill.

Examples

ASCII

Play forward at speed 1.0 from current frame

```
vdPlay
  (returns) "OK"
```

vdPlay

Play backward from frame 1000 at the slowest possible speed

vdPlay speed=.00001,direction=0,from=1000
(returns) "OK"

Play from current frame to 2000, don't return until it is reached

vdPlay to=2000,wait
(returns) "OK"

Play backward to frame 1

vdPlay to=1,direction=0
(returns) "ERROR 50"; Parameters cannot be used together

Play backward from 200 to 100

vdPlay from=200,to=100
(returns) "OK"
or
vdPlay to=100,from=200
(returns) "OK"

Play backward from the current frame

vdPlay direction=0
(returns) "OK"

Play all of chapter 2 at speed 1.0

vdPlay chapter=2
(returns) "OK"

Binary

Play from frame 200 to 500

	AX	3081	; **vdPlay** decimal ID
	BX	2	; number of parameters
	ES:DI[0]	24	; **from** decimal ID
	ES:DI[4]	200	; starting frame number
	ES:DI[8]	48	; **to** decimal ID
	ES:DI[C]	500	; ending frame number
After return	AX	0	; returns 0 if successful (nonzero if not)

vdScan

Last revision: R 1.0
Type: core

Parameters

ASCII

Parameter	Core or extended	Associated calling value	Type as ASCII	Associated return value	Type as ASCII	Default if parameter not used
device	Core	Logical player, 0–15	Integer	None	N/A	Default player
direction[1]	Core	1 (fwd) | 0 (back)	Integer	None	N/A	1
wait	Core	None	N/A	None	N/A	No wait
This command may be issued with no parameters.						

[1]Supported for CAV videodiscs only. All other parameters apply to both CAV and CLV videodiscs as does **vdScan** with no parameters.

Binary

Command code: 3083 decimal.

Parameter	Core or extended	Token number (decimal)	Type	Associated calling value	Associated return value	Default if parameter not used
device	Core	14	Integer	Logical player, 0–15	None	Default player
direction[1]	Core	15	Integer	1 (fwd) | 0 (back)	None	1
wait	Core	54	N/A	None	None	No wait
This command may be issued with no parameters.						

[1]Supported for CAV videodiscs only. All other parameters apply to both CAV and CLV videodiscs as does **vdScan** with no parameters.

Description

Summary

vdScan places the default or specified player in scan mode in an optional direction. The player plays at the maximum possible speed. The command continues until interrupted by a subsequent **vdPlay, vdInit, vdScan, vdSearch, vdSet spin=down, vdStep,** or **vdStill** command, or until the player reaches the edge of the videodisc. This command interrupts any other player motion command that did not include a **wait** parameter, in which case, the application will not be able to issue **vdScan** until the motion command is complete.

vdScan

No parameters — **vdScan** with no parameters starts scanning forward from the current frame.

Device parameter — The **device** parameter directs **vdScan** to the specified logical player number regardless of the default player number as set by **vdSet defdevice**. Specifying a nonexistent or uninstalled player causes error 160 (Invalid device number). Specifying an uninitialized player causes error 81 (Device not initialized).

Direction parameter — The **direction** parameter sets the direction of motion for the scan, either one (forward) or zero (backward).

Wait parameter — The **wait** parameter causes VDI Management to wait until it has confirmed that the player is in scan mode to return application control. Without **wait**, VDI Management returns control as soon as it determines that the command is legal. No error checking is done to determine if the player actually accepts the command or acts on it properly. Therefore, **syCheckErr** must be used to determine if the player entered an error state while either accepting or trying to execute the command.

Notes

1. Because **vdScan** often results in displaying parts of frames and does not accept parameters to limit the area of the videodisc that is scanned, the command is typically used during application development only.

Returns

ASCII

On success: "OK".

On failure: "ERROR n..."

Binary

On success: AX = 0.

On failure: AX = error number.

See also:

vdPlay, vdInit, vdScan, vdSearch, vdSet, vdStep, vdStill.

vdScan

Examples

ASCII

Scan forward from the current frame

```
vdScan
   (returns) "OK"
```

Scan backward on player 1, do not return until scan mode is confirmed

```
vdScan direction=0,device=1,wait
   (returns) "OK"
```

Binary

Scan backward on the default player

```
AX          3083        ; vdScan decimal ID
BX          2           ; number of parameters
ES:DI[0]    15          ; direction decimal ID
ES:DI[4]    0           ; direction in which to play (backward)
```

After return

```
AX          0           ; returns 0 if successful (nonzero if not)
```

vdSearch

Last revision: R 1.0
Type: core

Parameters

ASCII

Parameter	Core or extended	Associated calling value	Type as ASCII	Associated return value	Type as ASCII	Default if parameter not used
chapter	Core	Chapter number	Integer	None	N/A	No action
device	Core	Logical player, 0–15	Integer	None	N/A	Default player
frame[1]	Core	Frame number	Integer	None	N/A	No action
wait	Core	None	N/A	None	N/A	No wait
This command must include a **chapter** or **frame** or an error is returned. If **device** or **wait** is specified, at least one other parameter must be specified.						

[1]Supported for CAV videodiscs only. All other parameters apply to both CAV and CLV.

Binary

Command code: *3084 decimal.*

Parameter	Core or extended	Token number (decimal)	Type	Associated calling value	Associated return value	Default if parameter not used
chapter	Core	7	Integer	Chapter number	None	No action
device	Core	14	Integer	Logical player, 0–15	None	Default player
frame[1]	Core	23	Integer	Frame number	None	No action
wait	Core	54	N/A	None	None	No wait
This command must include a **chapter** or **frame** or an error is returned. If **device** or **wait** is specified, at least one other parameter must be specified.						

[1]Supported for CAV videodiscs only. All other parameters apply to both CAV and CLV.

Description

Summary

vdSearch causes the player to turn video off, immediately search for the specified frame number or the first frame of the specified chapter number, and freeze. This command interrupts any other player motion command that did not include a **wait** parameter, in which case, the application will not be able to issue **vdSearch** until the motion command is complete.

vdSearch

The resulting display after **vdSearch** varies with videodisc type. With CAV videodiscs, video remains visible. With most CLV videodiscs, **vdSearch** is equivalent to searching to the start of a chapter followed by a pause command. Typically, a CLV pause command automatically blanks video.

Chapter parameter

The **chapter** parameter specifies a chapter number to search to. The player displays the first frame of the specified chapter (CAV) or pauses and blanks video (CLV).

Specifying a **chapter** for a videodisc without chapter numbers causes error 208, (Action not supported by disc). Specifying an illegal chapter number causes error 216 (Invalid chapter number).

Device parameter

The **device** parameter directs **vdSearch** to the specified logical player number regardless of the default player number as set by **vdSet defdevice**. Specifying a nonexistent or uninstalled player causes error 160 (Invalid device number; specifying an uninitialized player causes error 81 (Device not initialized).

Frame parameter

The **frame** parameter specifies a frame number to search to. The player displays the specified frame.

Specifying a **frame** for a CLV videodisc causes error 208, (Action not supported by disc). Specifying an illegal frame number causes error 215 (Invalid frame number).

Wait parameter

The **wait** parameter causes VDI Management to wait until the specified **chapter** or **frame** has been reached to return application control. Without **wait**, VDI Management returns control as soon as it determines that the command is legal. No error checking is done to determine if the player actually accepts the command or acts on it properly. Therefore, **syCheckErr** must be used to determine if the player entered an error state while either accepting or trying to execute the command.

Returns

ASCII

On success: "OK".

On failure: "ERROR n..."

Binary

On success: AX = 0.

On failure: AX = error number.

See also: vdPlay, vdSet, vdStep, vdStill.

vdSearch

Examples

ASCII

Search for frame 23476

```
vdSearch frame=23476
  (returns) "OK"
```

Search for chapter 5 on player 1, do not return until the chapter has been reached

```
vdSearch chapter=5,device=1,wait
  (returns) "OK"
```

Binary

Search for frame 10356

```
AX          3084        ; vdSearch decimal ID
BX          1           ; number of parameters
ES:DI[0]    23          ; frame decimal ID
ES:DI[4]    10356       ; frame number for which to search
```

After return

```
AX          0           ; returns 0 if successful (nonzero if not)
```

vdSet

Last revision: R 1.0
Type: core

Parameters

ASCII

Parameter[1]	Core or extended	Associated calling value	Type as ASCII	Associated return value	Type as ASCII	Default if parameter not used
audio1	Core	1 (on) | 0 (off)	Integer	None	N/A	No action
audio2	Core	1 (on) | 0 (off)	Integer	None	N/A	No action
cdisplay	Core	1 (on) | 0 (off)	Integer	None	N/A	No action
defdevice	Core	Logical player, 0–15	Integer	None	N/A	No action
device	Core	Logical player, 0–15	Integer	None	N/A	Default player
door	Extended	1 (open) | 0 (closed)	Integer	None	N/A	No action
idxdisplay	Core	1 (on) | 0 (off)	Integer	None	N/A	No action
remote	Extended	1 (on) | 0 (off)	Integer	None	N/A	No action
spin	Core	1 (up) | 0 (down)	Integer	None	N/A	No action
video	Core	1 (on) | 0 (off)	Integer	None	N/A	No action
wait	Core	None	N/A	None	N/A	no wait
At least one parameter is required or an error is returned. If **device** or **wait** is specified, at least one other parameter must be specified.						

[1]All parameters apply to both CAV and CLV.

vdSet

Binary

Command code: 3085 decimal.

Parameter[1]	Core or extended	Token number (decimal)	Type	Associated calling value	Associated return value	Default if parameter not used
audio1	Core	2	Integer	1 (on) | 0 (off)	None	No action
audio2	Core	3	Integer	1 (on) | 0 (off)	None	No action
cdisplay	Core	6	Integer	1 (on) | 0 (off)	None	No action
defdevice	Core	12	Integer	Logical player, 0–15	None	No action
device	Core	14	Integer	Logical player, 0–15	None	Default player
door	Extended	18	Integer	1 (open) | 0 (closed)	None	No action
idxdisplay	Core	29	Real	1 (on) | 0 (off)	None	No action
remote	Extended	39	Integer	1 (on) | 0 (off)	None	No action
spin	Core	41	Integer	1 (up) | 0 (down)	None	No action
video	Core	51	Integer	1 (on) | 0 (off)	None	No action
wait	Core	54	N/A	None	None	No wait
At least one parameter is required or an error is returned. If **device** or **wait** is specified, at least one other parameter must be specified.						

[1]All parameters apply to both CAV and CLV.

Description

Summary

vdSet sets the default logical player number and other player conditions including the state of the audio and video channels, the frame and chapter number displays, the disc spin/park status, whether the door is open or closed, and whether the user remote control is on or off.

Audio1 and audio2 parameters

The **audio1** and **audio2** parameters enable and disable the player's stereo outputs. Setting both **audio1** and **audio2** to zero turns off all player audio.

Note: Many players automatically route the output of an enabled audio channel to a disabled channel. For example, if **audio1=0** and **audio2=1**, the player may automatically route the output of **audio2** to **audio1**.

Cdisplay parameter

The **cdisplay** parameter enables and disables the player's chapter-number display. This display is typically a character generator within the videodisc player that displays chapter-number information as part of the video signal.

vdSet

Defdevice parameter

The **defdevice** parameter sets the default logical player number. VDI Management directs all videodisc commands to this player number unless a command contains a **device** parameter (see below) directing it to a different player number.

Device parameter

The **device** parameter directs **vdSet** to the specified logical player number regardless of the default player number as set by **vdSet defdevice**. Specifying a nonexistent or uninstalled player causes error 160 (Invalid device number); specifying an uninitialized player causes error 81 (Device not initialized).

Door parameter

The **door** parameter opens and closes the videodisc player door. If the player does not support this function, the parameter returns error 87 (Action not supported by device). VDI implementers should implement **door** for a player that supports reporting the door's status even if the player does not support opening and closing the door from an application.

> **Door** is an extended parameter. Using an unimplemented extended parameter causes error 48 (Unknown parameter).

Idxdisplay parameter

The **idxdisplay** parameter enable and disable the player's position index display. The resulting display is in frame numbers for CAV videodiscs and time for CLV videodiscs. This display is typically a character generator within the videodisc player that displays videodisc position as part of the video signal.

Remote parameter

The **remote** parameter turns the hand held remote on and off. **Remote=0** (off) gives the application software complete control over the videodisc player. If the player does not support this function, remote returns error 87 (Action not supported by device).

> **Remote** is an extended parameter. Using an unimplemented extended parameter causes error 48 (Unknown parameter).

Spin parameter

The **spin** parameter spins the disc up and down. **Spin=1** (up) causes the player to spin up and still on frame 1 (or the first available frame). Spinning the videodisc up also updates the **disctype** parameter, and sets **cdisplay** to undefined for videodiscs that do not support chapter numbers.

Spin=0 (down) causes the player to spin down immediately, interrupting any player motion command not accompanied by the **wait** parameter, in which case, the application will not be able to issue **vdSet spin=0** until the motion command is complete.

vdSet

Video parameter The **video** parameter enables and disables the player's video output channel.

Wait parameter With the **wait** parameter, **vdSet** does not return application control until the specified settings have been acknowledged or a player error state is detected. Without **wait**, VDI Management returns control as soon as it determines that the command is legal. No error checking is done to determine if the player actually accepts the command or acts on it properly. Therefore, **syCheckErr** must be used to determine if the player entered an error state while either accepting or trying to execute the command.

Specifying **wait** with no other parameter results in error 49 (Insufficient parameters).

Notes

1. **vdSet** can be successfully issued any time the player can accept commands, except that **vdSet door=1** (open) can be issued only when **spin=0** (down) and the player has actually completed the spin down sequence.

Returns

ASCII

On success: "OK".

On failure: "ERROR n...".

Binary

On success: AX = 0.

On failure: Ax = error number.

See also:

syCheckErr, vdGetState.

Examples

ASCII

Turn off both number displays

```
vdSet idxdisplay=0,cdisplay=0
  (returns) "OK"
```

Disable hand-held remote control on player 1

```
vdSet remote=0,device=1
  (returns) "OK"
```

Make logical player 1 the default

```
vdSet defdevice=1
  (returns) "OK"
```

Turn on all player outputs

```
vdSet video=1,audio1=1,audio2=1
  (returns) "OK"
```

vdSet

Disable audio channel 1

vdSet audio1=0
(returns) "OK"

Binary

Turn on player index display

	AX	3085	; **vdSet** decimal ID
	BX	1	; number of parameters
	ES:DI[0]	29	; **idxdisplay** decimal ID
	ES:DI[4]	1	; set value to 1 (on)

After return

	AX	0	; returns 0 if successful (nonzero if not)

Set video on, audio channel 1 on, audio channel 2 off

	AX	3085	; **vdSet** decimal ID
	BX	3	; number of parameters
	ES:DI[0]	51	; **video** decimal ID
	ES:DI[4]	1	; set value to 1 (on)
	ES:DI[8]	2	; **audio1** decimal ID
	ES:DI[C]	1	; set value to 1 (on)
	ES:DI[10]	3	; **audio2** decimal ID
	ES:DI[14]	0	; set value to 0 (off)

After return

	AX	0	; returns 0 if successful (nonzero if not)

vdStep

Last revision: R 1.0
Type: core

Parameters

ASCII

Parameter[1]	Core or extended	Associated calling value	Type as ASCII	Associated return value	Type as ASCII	Default if parameter not used
device	Core	Logical player, 0–15	Integer	None	N/A	Default player
direction	Core	1 (fwd) | 0 (back)	Real	None	N/A	1
This command can be issued with no parameters.						

[1]No parameters apply to CLV videodiscs, nor does **vdStep** alone.

Binary

Command code: 3090 decimal.

Parameter[1]	Core or extended	Token number *(decimal)*	Type	Associated calling value	Associated return value	Default if parameter not used
device	Core	14	Integer	Logical player, 0–15	None	Default player
direction	Core	15	Integer	1 (fwd) | 0 (back)	None	1
This command can be issued with no parameters.						

[1]No parameters apply to CLV videodiscs, nor does **vdStep** alone.

Description

Summary **vdStep** causes the videodisc player to move forward or backward one frame at a time in a specified direction without blanking the screen. The command does not return application control until the step is complete. This command interrupts any other player motion command that did not include a **wait** parameter, in which case, the application will not be able to issue **vdPlay** until the motion command is complete.

No parameters With no parameters, **vdStep** steps forward one frame and freezes.

Device parameter The **device** parameter directs **vdStep** to the specified logical player number regardless of the default player number as set by **vdSet defdevice**. Specifying a nonexistent or uninstalled player causes error 160 (Invalid device number); specifying an uninitialized player causes error 81 (Device not initialized).

vdStep

Direction parameter

The **direction** parameter sets the direction of motion for the step, either one (forward) or zero (backward).

Notes

1. **vdStep** can be successfully issued any time the **spin=1** (up) as set by **vdSet**. However, issuing **vdStep** while a **vdPlay** sequence is in progress is not recommended because of the difficulty in determining which frames will be displayed.

Returns

ASCII

On success: "OK".

On failure: "ERROR n...".

Binary

On success: AX = 0.

On failure: Ax= error number.

See also:

syCheckerr, vdPlay, vdSet.

Examples

ASCII

Step forward 1 frame

```
vdStep
  (returns) "OK"
```

Step backward one frame

```
vdStep direction=0
  (returns) "OK"
```

Binary examples

Step forward one frame

```
AX      3090      ; vdStep decimal command ID
BX      0         ; number of parameters
```

After return

```
AX      = 0       ; returns 0 if successful (non-zero if not)
```

vdStill

Last revision: R 1.0
Type: core

Parameters

ASCII

Parameter	Core or extended	Associated calling value	Type as ASCII	Associated return value	Type as ASCII	Default if parameter not used
device[1]	Core	Logical player, 0–15	Integer	None	N/A	Default player
This command can be issued with no parameters.						

[1]This parameter applies to both CAV and CLV videodiscs as does **vdStill** with no parameters.

Binary

Command code: 3091 decimal.

Parameter	Core or extended	Token number (decimal)	Type	Associated calling value	Associated return value	Default if parameter not used
device[1]	Core	14	Integer	Logical player, 0–15	None	Default player
This command can be issued with no parameters.						

[1]This parameter applies to both CAV and CLV videodiscs as does **vdStill** with no parameters.

Description

Summary

vdStill causes the videodisc player to immediately stop on the current frame and sets the **motion** parameter returned by **vdGetState** to zero. This command interrupts any other player motion command that did not include a **wait** parameter, in which case, the application will not be able to issue **vdStill** until the motion command is complete.

The resulting display after **vdStill** varies with videodisc type. With CAV videodiscs, *video remains visible. With most CLV videodiscs,* **vdStill** is equivalent to a pause command and the player automatically blanks video.

Device parameter

The **device** parameter directs **vdStill** to the specified logical player number regardless of the default player number as set by **vdSet defdevice**. Specifying a nonexistent or uninstalled player causes error 160 (Invalid device number); specifying an uninitialized player causes error 81 (Device not initialized).

vdStill

Returns

ASCII

On success: "OK".

On failure: "ERROR n...".

Binary

On success: AX = 0.

On failure: Ax= error number.

See also:

vdPlay, vdScan, vdSet.

Examples

ASCII

Stop player motion

```
vdStill
  (returns) "OK"
```

Binary

Stop player motion

```
AX      3091    ; vdStill decimal ID
BX      0       ; number of parameters
```

After return

```
AX      0       ; returns 0 if successful (nonzero if not)
```

9 XY-input commands (xy)

This section describes commands that relate to XY-input devices such as mice, touchscreens, and light pens. These commands provide a uniform way to obtain information from these devices and define coordinate spaces. Table 9–1 lists the commands covered in this section, their token numbers, and their types.

Table 9–1. XY-input command names, token numbers, and types

ASCII command name[1]	Binary interface token number (decimal)	Type[2]
xyGetInput	4100	Core
xyGetState	4102	Core
xyInit	4103	Core
xySet	4109	Core

[1]Upper or lower case for command names is not significant.
[2]Compliant implementations must support "Core" commands.

9.1 General information and assumptions

The general information and assumptions in this subsection were used in the definition of the XY-input commands.

9.1.1 Device mapping

Typically, each physical XY-input device is treated independently and mapped to a unique logical device number. However, VDI implementers may opt to support multiple physical devices as a single logical device by mapping the devices to a single logical device number. If so, VDI Management must correct the raw values returned by the physical devices so that both devices return the same value for the same screen position to the application based on the application-coordinate space established with the **xySet** command.

All mapping must be done when VDI Management is installed. Devices cannot be remapped at run-time and mapping is not under application control. Mapping of multiple devices to a single logical device allows a user to use, for example, a mouse and a touchscreen that both appear to be the same device from the application's viewpoint.

Mapping the keyboard or cursor keypad to an XY-input device is optional. How such support is provided is an implementation issue and is not considered by the recommended practices.

Note that the xy service group keeps sets of all parameters that can be returned by **xyGetInput** and **xyGetState** for each logical device.

9.1.2 Handling the graphics plane and cursor

Well behaved applications should not turn off the graphics plane when they need selection and coordinate input. The plane must active for a device such as a mouse to display a cursor for making menu selections and similar tasks.

Although some XY-input devices such as touchscreens allow input beyond the limits of active graphics. applications should limit active XY-input areas to the active graphics plane. Again, this is necessary for devices such as mice that rely on the graphics plane for cursor display.

The application can determine if a device supports a graphics cursor with the xyGetState command. If the device does support a cursor, the application should turn it on for XY input.

9.1.3 Coordinate space mapping

The alignment of specific XY-coordinate values versus graphics is an implementation issue. However, the minimum and maximum values for X and Y always map to the edges of the active graphics area with the upper left corner of the graphics area as the origin, which is equal to **xmin** and **ymin**.

For example, if the minimum value for X is 0 and the maximum is 10, these map to the left and right edges of active graphics (typically 0 and 319 or 0 and 639), respectively. If the minimum and maximum values are -100 and +100, these still map to the left and right edges of active graphics.

The clipping values for X and Y cannot lie outside of the minimum and maximum values. Trying to set clipping values outside of the minimum and maximum values causes an error.

For relative positioning devices such as mice, VDI Management ignores changes in position which take the cursor outside of the clipping area. For absolute positioning devices such as touchscreens, VDI Management ignores

button presses outside of the clipping area. Application authors should note that the behavior differs between the two device classes and should consider testing applications against both.

Calibrating the XY-coordinate space to the active graphics area is an implementation and application issue. Typically, if a device such as a touchscreen requires calibration, the device comes with software to support its calibration at installation.

9.1.4 Buttons

In the context of the XY-command set, a button is any device that allows signaling the application that a choice has been made. A button press may consist of touching a finger to a touchscreen or pressing a physical button on a mouse. The command set supports devices with multiple buttons. However, applications should assume single-button devices for maximum portability.

The command set supports reporting only whether a button has been pressed. It does not distinguish touchdown, liftoff, or intensity (Z dimension). Supporting these variations is an application issue and is nonportable.

9.2 Stream-mode and point-mode devices

XY-input devices fall into two broad categories based on how they make positional information available—stream-mode and point-mode. Some devices support one mode only, while others support both depending on configuration.

In stream mode, devices make position and selection information available on a continuous basis. Software can ask for and receive current information at any time. In point mode, devices make position and selection information available only when a button is being pressed.

Stream-mode devices can be forced into point mode by restricting their functionality. However, such reduced functionality would place unwarranted restrictions on application design. Therefore, *VDI Management treats all XY-input devices as stream-mode devices.*

To treat both true stream-mode devices and point-mode devices as stream-mode devices, the reported coordinates will be one of:

- the current coordinates from a true stream-mode device; or
- the coordinates at the time the button was last pressed for a point-mode device; or
- the minimum X and Y values (typically 0,0) for a point-mode device for which no button has been pressed since the device was initialized.

xyGetInput

Last revision: R 1.0

Type: core

Parameters

ASCII

Parameter	Core or extended	Associated calling value	Type as ASCII	Associated return value	Type as ASCII	Default if parameter not used
buttons	Core	None	N/A	Integer sum of bit field, 1 (closed) | 0 (open)	Integer	No action
device	Core	Logical input device, 0–15	Integer	None	N/A	Default device
xpos	Core	None	N/A	Current X value	Integer	No action
ypos	Core	None	N/A	Current Y value	Integer	No action
At least one parameter is required or an error is returned. If **device** is specified, at least one other parameter must be specified.						

Binary

Command code: 4100 decimal.

Parameter	Core or extended	Token number (decimal)	Type	Associated calling value	Associated return value	Default if parameter not used
buttons	Core	5	Integer	Any value	Bit field, 1 (closed) | 0 (open)	No action
device	Core	14	Integer	Logical input device, 0–15	None	Default device
xpos	Core	61	Integer	Any value	Current X value	No action
ypos	Core	67	Integer	Any value	Current Y value	No action
At least one parameter is required or an error is returned. If **device** is specified, at least one other parameter must be specified.						

Description

Summary **xyGetInput** returns the current position and button status of the XY-input device.

xyGetInput

Buttons parameter

The **button** parameter returns the state of all buttons as a bit field. Each bit in the bit field can have two states—zero (open) or one (closed). A device can have up to 32 buttons numbered 0–31.

The binary interface returns a 4-byte bit field. The least significant bit (bit 0) of the least significant byte (byte 0) corresponds to button zero, the next bit to button one, and so on. For example, if an input device had three buttons with states of closed, open, closed, the binary interface would return 00000101B in the low byte.

The ASCII interface returns the same bit field as an integer value. For the example above, the ASCII interfaces would return "5" (4 + 0 + 1).

Device parameter

The **device** parameter directs **xyGetInput** to the specified logical XY-input device regardless of the default device number as set by **xySet defdevice**.

Specifying **device** with no other parameter returns error 49 (Insufficient parameters). Specifying a nonexistent or uninstalled device returns error 160 (Invalid device number). Specifying an uninitialized device causes error 81 (Device not initialized).

Xpos and ypos parameters

*The **xpos** and **ypos** parameters return the current* XY coordinates of the input device according to the scale set by **xySet**.

Notes

1. **xyGetState tbuttons** returns the number of buttons available on a device.
2. Trying to queue **xyGetInput** causes error 177 (Command cannot be queued) at the time of the attempt.

Returns

ASCII

On success: Comma-separated list of values for requested parameters as described above.

On failure: "ERROR n...".

Binary

On success: AX = 0. Values associated with requested parameters are 32-bit values of the types given in the binary parameter table above.

On failure: AX = error number. Any return values in the parameter block addressed by ES:DI are undefined and should be ignored.

See also:

xyGetState, xySet.

xyGetInput

Examples

ASCII

Get current X position

xyGetInput xpos
(returns) "43" ; the current X coordinate is 43

Get current XY positions and state of buttons

xyGetInput xpos,ypos,buttons
(returns) "43,110,1" ; XY coordinates are 43,110 and button 1 is closed

Get XY positions for input device 2

xyGetInput device=2,xpos,ypos
(returns) "128,145" ; device 2 XY coordinates are 128, 145

Binary

Get current XY and buttons values

```
AX          4100          ; xyGetInput decimal ID
BX          3             ; number of parameters
ES:DI[0]    61            ; xpos decimal ID
ES:DI[4]    any value     ; place holder for xpos value after return
ES:DI[8]    67            ; ypos decimal ID
ES:DI[C]    any value     ; place holder for ypos value after return
ES:DI[10]   5             ; buttons decimal ID
ES:DI[14]   any value     ; place holder for button bit field after return
```

After return

```
AX          0             ; returns 0 if successful (nonzero if not)
ES:DI[4]    X position    ; X position
ES:DI[C]    Y position    ; Y position
ES:DI[14]   bit field     ; button status bit field
```

xyGetState

Last revision: R 1.0
Type: core

Parameters

ASCII

Parameter	Core or extended	Associated calling value	Type as ASCII	Associated return value	Type as ASCII	Default if parameter not used
cursor	Extended	None	N/A	1 (on) | 0 (off)	Integer	No action
defdevice	Core	None	N/A	Default input device, 0–15	Integer	No action
device	Core	Logical input device, 0–15	Integer	None	N/A	Default device
tbuttons	Core	None	N/A	Total available for device	Integer	No action
tdevices	Core	None	N/A	Total installed for, 0–15	Integer	No action
xmax	Core	None	N/A	Maximum possible X value	Integer	No action
xmaxclip	Core	None	N/A	Current maximum X value	Integer	No action
xmin	Core	None	N/A	Minimum possible X value	Integer	No action
xminclip	Core	None	N/A	Current minimum X value	Integer	No action
ymax	Core	None	N/A	Maximum possible Y value	Integer	No action
ymaxclip	Core	None	N/A	Current maximum Y value	Integer	No action
ymin	Core	None	N/A	Minimum possible Y value	Integer	No action
yminclip	Core	None	N/A	Current minimum Y value	Integer	No action
At least one parameter is required or an error is returned. If **device** is specified, at least one other parameter must be specified.						

xyGetState

Binary

Command code: 4102 decimal.

Parameter	Core or extended	Token number (decimal)	Type	Associated calling value	Associated return value	Default if parameter not used
cursor	Extended	11	Integer	Any value	1 (on) | 0 (off)	No action
defdevice	Core	12	Integer	Any value	Default input device, 0–15	No action
device	Core	14	Integer	Logical input device, 0–15	None	Default device
tbuttons	Core	44	Integer	Any value	Total available for device	No action
tdevices	Core	45	Integer	Any value	Total installed for, 0–15	No action
xmax	Core	56	Integer	Any value	Maximum possible X value	No action
xmaxclip	Core	57	Integer	Any value	Current maximum X value	No action
xmin	Core	58	Integer	Any value	Minimum possible X value	No action
xminclip	Core	59	Integer	Any value	Current minimum X value	No action
ymax	Core	62	Integer	Any value	Maximum possible Y value	No action
ymaxclip	Core	63	Integer	Any value	Current maximum Y value	No action
ymin	Core	64	Integer	Any value	Minimum possible Y value	No action
yminclip	Core	65	Integer	Any value	Current minimum Y value	No action
At least one parameter is required or an error is returned. If **device** is specified, at least one other parameter must be specified.						

Description

Summary

xyGetState returns information about the current values of the coordinate space, and available devices and capabilities. VDI Management maintains a copy of device-specific parameters including coordinates for each logical device.

xyGetState

Cursor parameter

The **cursor** parameter returns one if the graphics cursor is visible. **Cursor** returns zero if the input device supports a cursor that is not visible or the device does not support a cursor, in which case, the cursor must always be off.

> **Cursor** is an extended parameter. Using an unimplemented extended parameter causes error 48 (Unknown parameter).

Defdevice parameter

The **defdevice** parameter returns the logical number of the default XY-input device as by **xySet defdevice**. VDI management directs all XY commands to this device unless a command includes a **device** parameter (see below) directing it to a different input device.

Device parameter

The **device** parameter directs **xyGetState** to the specified logical device number regardless of the default device number as set by **xySet defdevice**. Because, in general, **device** affects the command with which it is associated only, the parameter does not affect the return value for **defdevice** (see above) when the two parameters are used together.

Specifying **device** with no other parameter returns error 49 (Insufficient parameters). Specifying a nonexistent or uninstalled device returns error 160 (Invalid device number). Specifying an uninitialized device causes error 81 (Device not initialized).

Tbuttons parameter

The **tbuttons** parameter returns the total number of buttons available for the default or specified XY-input device.

Tdevices parameter

The **tdevices** parameter returns the total number of logical XY-input devices for which VDI Management was configured at installation. If only one device is installed, it is numbered zero and **tdevices** returns one. This parameter alerts the application to systems that have more than one available input device, for example a mouse and touch screen.

Xmin, ymin, xmax, and ymax parameters

The **xmin, ymin, xmax, ymax** parameters return the current scaling of the XY-coordinate system. The **xmin** and **ymin** values are the coordinates corresponding to the physical location of the upper left corner of the *active* graphics area. The **xmax** and **ymax** values correspond to the lower right corner of the active graphics area. VDI Management scales absolute positioning information to the space defined by these parameters.

xyGetState

Xminclip, yminclip, xmaxclip, and ymaxclip parameters

The **xminclip, yminclip, xmaxclip,** and **ymaxclip** parameters return the area within the XY-coordinate space within which changes of position are reported.

Parameters resulting in errors

If a parameter causes an error, **xyGetState** returns immediately with the error message. The command does not return partial responses for other parameters that did not cause errors.

Notes

1. Trying to queue **xyGetState** causes error 177 (Command cannot be queued) at the time of the attempt.

Returns

ASCII

On success: Comma-separated list of values for requested parameters as described above.

On failure: "ERROR n...".

Binary

On success: AX = 0. Values associated with requested parameters are 32-bit values of the types given in the binary parameter table above.

On failure: AX = error number. Any return values in the parameter block addressed by ES:DI are undefined and should be ignored.

See also:

syGetState, vdGetState, vmGetState, xyGetInput, xyInit, xySet.

Examples

ASCII

Get total devices, and default device	xyGetState tdevices,defdevice (returns) "2,1"	; two devices, number 1 is selected
Get current XY-coordinate space	xyGetState xmin,ymin,xmax,ymax (returns) "0,0,639,199"	; x values will be between 0 and 639, ; and y values between 0 and 199
Get available buttons for device 2	xyGetState tbuttons,device=2 (returns) "3"	; three buttons available

xyGetState

Binary

Determine if cursor is on	AX	4102	; **xyGetState** decimal ID
	BX	1	; number of parameters
	ES:DI[0]	11	; **cursor** decimal ID
	ES:DI[4]	any value	; place holder for **cursor** value after return
After return	AX	0	; returns 0 if successful (nonzero if not)
	ES:DI[4]	1	; graphics cursor is on (0 = off)

xyInit

Last revision: R 1.0

Type: core

Parameters

ASCII

Parameter	Core or extended	Associated calling value	Type as ASCII	Associated return value	Type as ASCII	Default if parameter not used
device	Core	Logical input device, 0–15	Integer	None	N/A	Default device
This command can be issued with no parameters.						

Binary

Command code: 4103 decimal.

Parameter	Core or extended	Token number (decimal)	Type	Associated calling value	Associated return value	Default if parameter not used
device	Core	14	Integer	Logical input device, 0–15	None	Default device
This command can be issued with no parameters.						

Description

Summary

xyInit initializes XY-input hardware and the **xy** service group, placing both in a known state. **xyInit** *must* be issued for each attached XY-input device that will be used by the application.

Device parameter

The **device** parameter specifies the logical number of the XY-input device to be initialized. If **device** is omitted, **xyInit** initializes the default device as set by **xySet defdevice**. If **xySet** has not been used to set a default input device, the default device is defined to be number zero. **xyInit** does not change the default input device if a **device** other than the default is specified. To change the default, use **xySet defdevice**.

Specifying a nonexistent or uninstalled device returns error 160 (Invalid device number).

xyInit

Conditions set by xyInit

xyInit sets the parameters in the following table to the specified values.

Parameter values set by xyInit		
Parameter	**Value**	**Command reference**
tbuttons	Total available for device being initialized	none
tdevices	Total installed, 0–15	none
xmax	639	xySet
xmaxclip	639	xySet
xmin	0	xySet
xminclip	0	xySet
xpos	0	xySet
ymax	199	xySet
ymaxclip	199	xySet
ymin	0	xySet
yminclip	0	xySet
ypos	0	xySet

Notes

1. **xyGetState tdevices** returns the total number of XY-input devices for which VDI Management was installed. This command can be used after the first **xyInit** to determine the number of additional devices to initialize.
2. Trying to queue **xyInit** causes error 177 (Command cannot be queued) at the time of the attempt.

Returns

ASCII

On success: "OK".

On failure: "ERROR n...".

Binary

On success: AX = 0.

On failure: AX = error number.

See also:

syInit, vdInit, vmInit, xyGetState, xySet.

xyInit

Examples

ASCII

Initialize device 0 and xy service group	xyInit (returns) "OK"		; first time command is issued
Initialize device 1	xyInit device=1 (returns) "OK"		; device 1 successfully initialized

Binary

Initialize device 0 and xy service group	AX	4103	; **xyInit** decimal ID
	BX	0	; number of parameters
After return	AX	0	; returns 0 if successful (nonzero if not)

xySet

Last revision: R 1.0
Type: core

Parameters

ASCII

Parameter	Core or extended	Associated calling value	Type as ASCII	Associated return value	Type as ASCII	Default if parameter not used
cursor	Extended	1 (on) | 0 (off)	Integer	None	N/A	No action
defdevice	Core	Logical input device, 0–15	Integer	None	N/A	No action
device	Core	Logical input device, 0–15	Integer	None	N/A	Default device
xmax	Core	Maximum possible X value	Integer	None	N/A	No action
xmaxclip	Core	Current maximum X value	Integer	None	N/A	No action
xmin	Core	Minimum possible X value	Integer	None	N/A	No action
xminclip	Core	Current minimum X value	Integer	None	N/A	No action
xpos	Core	X position	Integer	None	N/A	No action
ymax	Core	Maximum possible Y value	Integer	None	N/A	No action
ymaxclip	Core	Current maximum Y value	Integer	None	N/A	No action
ymin	Core	Minimum possible Y value	Integer	None	N/A	No action
yminclip	Core	Current minimum Y value	Integer	None	N/A	No action
ypos	Core	Y position	Integer	None	N/A	No action
At least one parameter is required or an error is returned. If **device** is specified, at least one other parameter must be specified.						

xySet

Binary

Command code: 4109 decimal.

Parameter	Core or extended	Token number (decimal)	Type	Associated calling value	Associated return value	Default if parameter not used
cursor	Extended	11	Integer	1 (on) | 0 (off)	None	No action
defdevice	Core	12	Integer	Logical input device, 0–15	None	No action
device	Core	14	Integer	Logical input device, 0–15	None	Default device
xmax	Core	56	Integer	Maximum possible X value	None	No action
xmaxclip	Core	57	Integer	Current maximum X value	None	No action
xmin	Core	58	Integer	Minimum possible X value	None	No action
xminclip	Core	59	Integer	Current minimum X value	None	No action
xpos	Core	61	Integer	X position	None	No action
ymax	Core	62	Integer	Maximum possible Y value	None	No action
ymaxclip	Core	63	Integer	Current maximum Y value	None	No action
ymin	Core	64	Integer	Minimum possible Y value	None	No action
yminclip	Core	65	Integer	Current minimum Y value	None	No action
ypos	Core	67	Integer	Y position	None	No action
At least one parameter is required or an error is returned. If **device** is specified, at least one other parameter must be specified.						

Description

Summary

xySet defines the XY-coordinate space, sets the default input device, turns the cursor on and off, and sets the current XY coordinates. Each parameter stays in effect for either the current or specified device regardless of the graphics mode until reset with **xySet** or **xyInit**.

xySet

Cursor parameter

The **cursor** parameter enables and disables a graphics cursor if one is available. For example, if the device is a mouse, **xySet cursor=1** enables the cursor and makes it visible. Updating the position of such a cursor is a background function. If the input device does not support a cursor, turning the cursor on returns error 87 (Action not supported by device).

> **Cursor** is an extended parameter. Using an unimplemented extended parameter causes error 48 (Unknown parameter).

Defdevice parameter

The **defdevice** parameter specifies the default input device to be used when more than one input device is available. Specifying a nonexistent or uninstalled device returns error 160 (Invalid device number). Specifying an uninitialized device causes error 81 (Device not initialized).

Device parameter

The **device** parameter directs **xySet** to the specified logical device number regardless of the default input device as set by **xySet defdevice** (see above).

Specifying **device** *with no other parameter* returns error 49 (Insufficient parameters). Specifying a nonexistent or uninstalled device returns error 160 (Invalid device number). Specifying an uninitialized device causes error 81 (Device not initialized).

Xmin, ymin, xmax, and ymax parameters

The **xmin**, **ymin**, **xmax**, and **ymax** parameters set the scaling of the XY-coordinate space to the physical screen. The values correspond to the upper left and lower right corners of the active graphics display area. Legal Values range -32768–32767. Regardless of the values, **xmin** and **xmax** always map to the left and right edges of the screen, respectively; **ymin** and **ymax** always map to the top and bottom edges.

Xminclip, yminclip, xmaxclip, and ymaxclip parameters

The **xminclip**, **yminclip**, **xmaxclip**, and **ymaxclip** parameters define a constrained area within the coordinate space for reporting coordinate movement. Coordinates values are returned only within the defined clip area. The clipping area is initially defined to be the same as **xmin**, **ymin**, **xmax**, and **ymax**. Specifying a clipping value outside the scaling of the XY-coordinate system (see above) returns error 51 (Parameter value invalid or out of range).

Xpos and ypos parameters

The **xpos** and **ypos** parameters set the XY coordinates to a specific location. These parameters are especially useful for initially positioning the XY-input device. An **xpos** or **ypos** value outside the clipping values (see above) sets the coordinate to the limit of the respective clipping range.

xySet

Notes

1. **xyGetState tdevices** returns the number of input devices that can be selected by **xySet defdevice**, assuming all devices for which VDI Management was installed are available.

Returns

ASCII

On success: "OK".

On failure: "ERROR n...".

Binary

On success: AX = 0.

On failure: AX = error number.

See also:

xyGetInput, xyGetState, xyInit.

Examples

ASCII

Set XY position

```
xySet xpos=40,ypos=50
  (returns) "OK"          ; XY position is 40,50
```

Turn device 2 cursor on

```
xySet device=2,cursor=1
  (returns) "OK"
```

Match coordinate space to VGA max

```
xySet xmin=0,ymin=0,xmax=639,ymax=479
  (returns) "OK"
```

Set maximum clipping values

```
xySet xmaxclip=200,ymaxclip=200
  (returns) "OK"          ; report change if X or Y is less than 200
```

Binary examples

Turn on XY cursor

```
AX        4109      ; xySet decimal ID
BX        1         ; number of parameters
ES:DI[0]  11        ; cursor decimal ID
ES:DI[4]  1         ; turn cursor on
```

After return

```
AX        0         ; returns 0 if successful (nonzero if not)
```

A Default positions of graphics relative to video

This appendix explains how to determine the size and position of graphics relative to background video. To ensure the compatibility of hardware, VDI Management software, and applications, the active graphics screen for a given application should always have the same position relative to the active video and be of the same size. However, the proper position of graphics can vary with the video standard (NTSC versus PAL), the graphics mode, and the adapter type (VGA versus CGA and EGA).

Although exact registration and graphics screen sizes—within one or two pixels or lines—may require user calibration using a position reference frame, proper registration can be calculated with reasonable accuracy. The following sections explain how to determine horizontal and vertical graphics positions for both NTSC and PAL video.

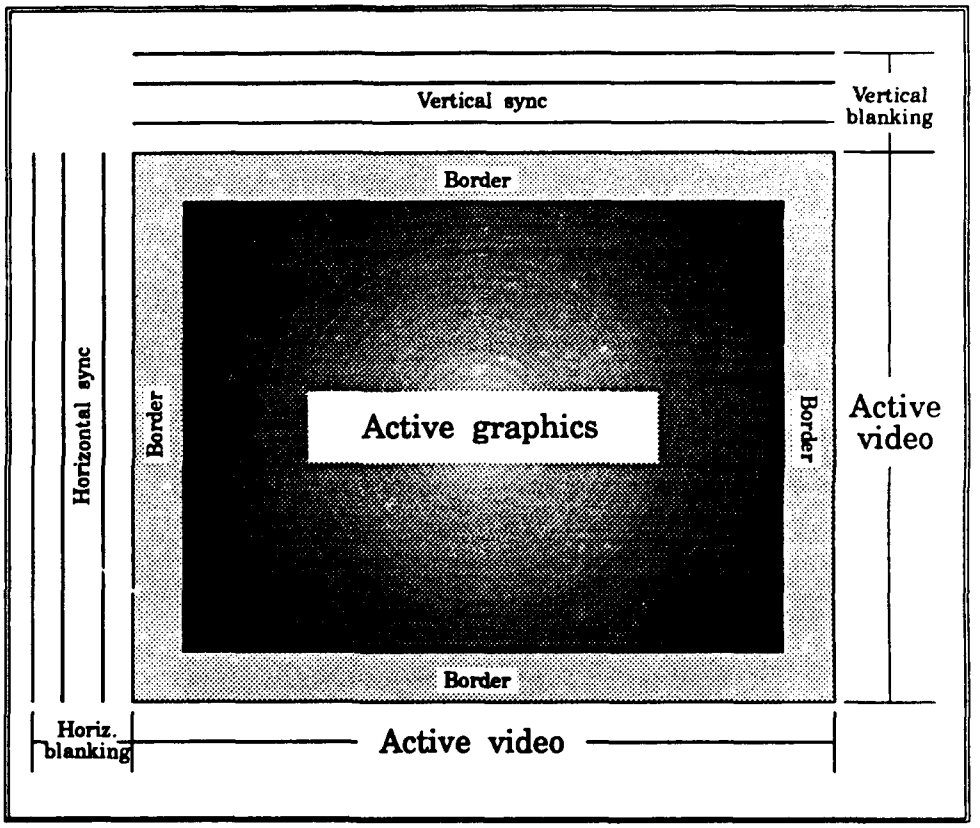
Because no absolute specification exists for the size and position of the background video and because the position can vary in post-production generation of videodiscs, the recommended positions in this appendix are guidelines for a nominal video image. If exact positioning is critical, the videodisc for the application should include a reference frame for user calibration at run time. This requires VDI Management implementations to support dynamic repositioning of graphics.

Proper registration requires accurately setting the graphics width as well as the origin. Correctly setting the origin but using the wrong width results in improper registration on the right side of the video. Generating the graphics clock so that exactly 912 clock cycles equal 1 horizontal period assures proper width. If an overlay method does not guarantee this relationship, implementers must provide a way to adjust the graphics width and the reference frame must provide both left and right registration information.

A.1 Terms of reference

Figure A–1 shows a simplified display screen including video, graphics, sync signals, and blanking intervals. For simplicity, the figure shows separate horizontal and vertical sync signals. Although these signals may be thought of as separate for determining graphics positions, they may be combined into a composite signal in actual monitors.

Figure A–1. A simplified diagram of an overlayed display using CGA or EGA graphics



The remaining sections of this appendix use the following terms:

1. **Active graphics:** The portion of the screen where graphics can appear.
2. **Active video:** The portion of the screen where video can appear. This is the portion of horizontal and vertical video not blanked by horizontal and vertical blanking.
3. **Border:** The portion of active video not covered by active graphics.
4. **Horizontal blanking:** The time period during which the display is blank for horizontal retracement.

5. **Horizontal sync:** The pulse used to synchronize the horizontal scan of the video monitor.
6. **Vertical blanking:** The time period during which the display is blank for vertical retracement.
7. **Vertical sync:** The pulse used to synchronize the vertical scan of the video monitor.

The values used in the figures and calculations for horizontal and vertical positioning are based on accepted definitions for NTSC and PAL video. The corresponding standards are EIA RS–170A and CCIR 470–1, respectively.

A.2 Special considerations for VGA graphics

VGA graphics require special consideration for two reasons. The first deals with the differences in background video signals and vertical timing. The second deals with differences in active graphics sizes for the same video modes when considering VGA graphics versus CGA and EGA graphics.

A.2.1 Differences in signals and timing

CGA and EGA graphics overlay systems typically use standard 15-kHz background video. For these systems, accepted video standards dictate blanking interval widths and the starts of horizontal and vertical sync. Therefore, CGA and EGA systems can use the starts of horizontal and vertical sync as absolute references for graphics positioning and rely on constant horizontal signal widths and vertical timing for a given video standard, either NTSC or PAL.

However, VGA systems typically use scan-altered, non-15-kHz modes. The background video for VGA may not include horizontal or vertical sync and blanking interval widths may vary. Therefore, graphics positioning must use the nominal start of active video as a reference instead of the start of sync and positioning must be relative to the active video rather than the total video including blanking.

A.2.2 Differences in the size of active graphics

By increasing pixel width, VGA graphics cover the entire width of active video, leaving borders at the top and bottom of active graphics only. However, a CGA or EGA adapter used to display graphics in the same mode leaves a border around all edges of the active graphics.

For example, VGA mode 6 (640 × 200) graphics cover the entire width of the active video, while mode 6 (640 × 200) graphics from a CGA or EGA adapter leave a visible video border around all edges of the active graphics. Therefore, compliant VDI Management implementations for VGA overlay systems must

support both graphics that map to the left and right edges of active video and, for those modes that are CGA/EGA-compatible, emulations of true CGA and EGA systems that leave a border around all edges of active graphics.

A.3 Horizontal positions

This section explains how to determine the start and end of active graphics relative to a horizontal video signal. The horizontal position of graphics relative to video can be expressed as a proportion of the horizontal video signal width, which is abbreviated H. Using proportions simplifies determining positions for scan-altered systems.

Because horizontal sync is the timing reference from which all horizontal components are measured in 15-kHz video, true CGA and EGA graphics use the start of horizontal sync as a reference and positions can be expressed as proportions of total H. Because VGA video and graphics may not include a horizontal sync signal and the width of the blanking intervals may vary, VGA graphics modes that emulate CGA and EGA modes are measured from the nominal start of active video and expressed as a proportion of active H.

A.3.1 General assumptions

The following general assumptions are used in determining the horizontal positions of active graphics relative to NTSC and PAL video.

1. The optimal position for active graphics is centered horizontally in the active video.

   Basis: Nominal common practice. However, variations in graphics positioning due to monitor centering adjustments cannot be accounted for in the recommendations in this appendix.

2. One horizontal line of graphics is 912 pixels in length. The active graphics consist of a 640-pixel window.

   Basis: Apple II and IBM CGA standards define a 640-pixel active graphics window in a 912-pixel horizontal line. The graphics are about 85% of the total displayable window to allow for monitor overscan.This has become a *de facto* standard that is also used by EGA graphics. CGA- and EGA-based overlay systems generally follow this standard.

3. Because color graphics standards are based on a line length of 912 pixels, 1/912 H or approximately 0.0011 H is the finest positioning resolution available

   Basis: Original IBM CGA implementation.

3. Graphics with 320-pixel active areas cover exactly the same horizontal area as graphics with 640-pixel active areas. Therefore, starting and

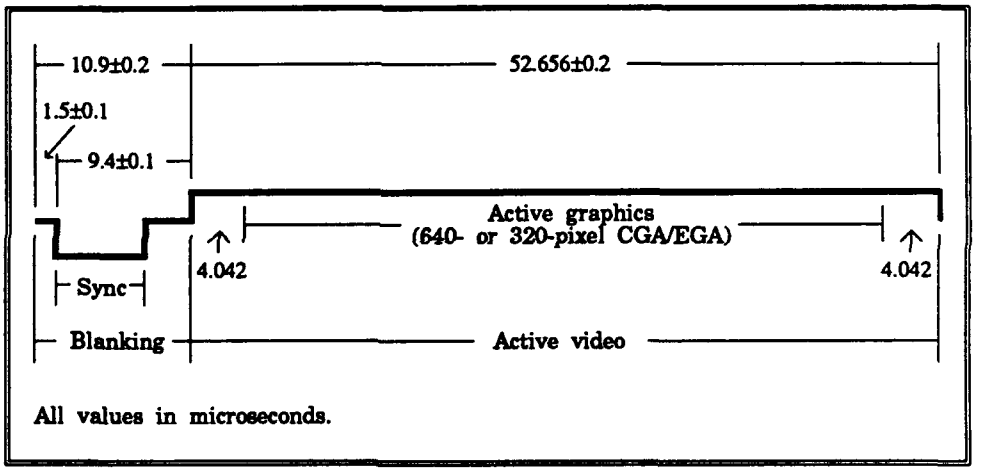
ending positions based on calculations using 640 pixels are valid for 320-pixel graphics.

Basis: The pixel width for 320-pixel graphics modes is exactly twice the width for 640-pixel graphics and the number of pixels for 320-pixel graphics is exactly one half the number of pixels for 640-pixel modes.

A.3.2 NTSC

Figure A–2 shows the timing for one line of 15-kHz NTSC video including the position of CGA and EGA 640- or 320-pixel graphics. The timing values in the figure are either taken directly from or derived from the accepted standard for NTSC video. The calculations in this section are based on the values shown in the figure.

Figure A–2. One horizontal line of NTSC video with 640- or 320-pixel overlayed graphics



Position of true CGA and EGA graphics

To determine the correct position of true CGA and EGA graphics over video as a fraction of a horizontal, 15.734-kHz, NTSC, video signal given the timing shown in Figure A–2, use the following equations and assumptions for 640-pixel graphics. Note that the resulting positions hold for 320-pixel graphics.

The general equation for the starting position of true CGA and EGA graphics centered in active video as a proportion of total H using the start of sync as a reference can be expressed as:

$$(1)\quad GH_{start} = \frac{AV_{start} + \frac{(P_{active} - P_{displayed}) \times P_{width}}{2}}{H_{total}}$$

Similarly, the general equation for determining the ending position of true CGA and EGA graphics as a proportion of total H can be expressed as:

$$(2)\quad GH_{end} = \frac{AV_{start} + \frac{(P_{active} - P_{displayed}) \times P_{width}}{2} + (P_{displayed} \times P_{width})}{H_{total}}$$

Where, *GH* stands for "graphics horizontal," and for NTSC video and 640-pixel resolutions:

1. The nominal start of active video is:

   $AV_{start} = 9.4\ \mu s$

   from Figure A–2.

2. The total number of pixels corresponding to the width of active video is:

   $$P_{active} = \frac{52.656\ \mu s}{63.556\ \mu s} \times 912\ pixels \approx 756\ pixels$$

   from Figure A–2 and the *de facto* standard (see assumption 2 in Section A.3.1).

3. The total number of displayed pixels is:

   $P_{displayed} = 640\ pixels$

   from the *de facto* standard (see assumption 2 in Section A.3.1).

4. The total width of the video signal is

   $H_{total} = 63.556\ \mu s$

   from Figure A–2.

5. The width of one pixel is

   $$P_{width} = \frac{63.556 \mu s}{912} = 0.06969\ \mu s$$

Solving equation 1 for the starting position of 640-pixel graphics yields:

$$GH_{start} = \frac{9.4 + \frac{(756 - 640) \times 0.06969}{2}}{63.556} = 0.2115\ H_{total}$$

Solving equation 2 for the ending position of 640-pixel graphics yields:

$$GH_{end} = \frac{9.4 + \frac{(756 - 640) \times 0.06969}{2} + (640 \times 0.06969)}{63.556} = 0.9133\ H_{total}$$

For NTSC video these values equate to left and right border widths of 4.042 µs and a start of active graphics at approximately 13.4 µs after the start of horizontal sync. The latter value can be reliably verified with an accurate oscilloscope.

Position of VGA graphics emulating CGA and EGA modes

True VGA graphics map to the edges of active video and require no calculations. However, the starting and ending positions of VGA graphics emulating CGA and EGA graphics must be calculated. To determine the correct position of such graphics over video as a fraction of a horizontal, 15.734-kHz, NTSC, video signal given the timing shown in Figure A–2, use the following equations and assumption for 640-pixel graphics. Note that the resulting positions hold for 320-pixel graphics.

The general equation for the starting position of VGA emulating CGA and EGA graphics centered in active video as a proportion of active H using the nominal start of video as a reference can be expressed as:

$$(3)\quad GH_{start} = \frac{\frac{(P_{active} - P_{displayed}) \times P_{width}}{2}}{H_{active}}$$

Similarly, the general equation for determining the ending position of VGA graphics emulating CGA and EGA graphics as a proportion of active H can be expressed as:

$$(4)\quad GH_{end} = \frac{\frac{(P_{active} - P_{displayed}) \times P_{width}}{2} + (P_{displayed} \times P_{width})}{H_{active}}$$

These equations are identical to equations 1 and 2 in the previous section except that AV_{start} is now equal to zero and therefore dropped from the equations and that H_{total} has been changed to H_{active} where:

$$H_{active} = 52.656\ \mu s$$

from Figure A–2.

Solving equation 3 for the starting position of 640-pixel graphics yields:

$$GH_{start} = \frac{\frac{(756 - 640) \times 0.06969}{2}}{52.656} = 0.0768\ H_{active}$$

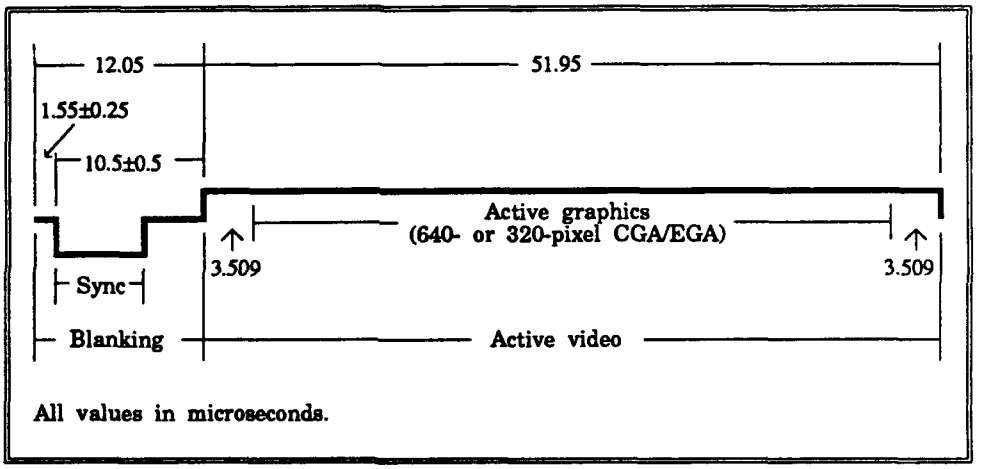
Solving equation 4 for the ending position of 640-pixel graphics yields:

$$GH_{end} = \frac{\frac{(756 - 640) \times 0.06969}{2} + (640 \times 0.06969)}{52.656} = 0.924\ H_{active}$$

A.3.3 PAL

Figure A–3 shows the timing for one line of 15-kHz PAL video including the position of CGA and EGA 640- and 320-pixel graphics. The timing values in the figure are either taken directly from or derived from the accepted standard for PAL video. The calculations in this section are based on the values shown in the figure.

Figure A–3. One horizontal line of PAL video with 640- and 320-pixel overlayed graphics



The general equations used to calculate graphics positions for PAL are identical to those for NTSC. However, the values used for the equation variables differ because of differences in horizontal timing. For convenience, all equations and variable values are repeated in the following sections.

Position of true CGA and EGA graphics

To determine the correct position of true CGA and EGA graphics over video as a fraction of a horizontal, 15.625-kHz, PAL, video signal given the timing shown in Figure A–3, use the following equations and assumptions for 640-pixel graphics. Note that the resulting positions hold for 320-pixel graphics.

The general equation for the starting position of true CGA and EGA graphics centered in active video as a proportion of total H using the start of horizontal sync as a reference can be expressed as:

$$(5)\quad GH_{start} = \frac{AV_{start} + \frac{(P_{active} - P_{displayed}) \times P_{width}}{2}}{H_{total}}$$

Similarly, the general equation for determining the ending position of true CGA and EGA graphics as a proportion total H width can be expressed as:

$$(6)\quad GH_{end} = \frac{AV_{start} + \frac{(P_{active} - P_{displayed}) \times P_{width}}{2} + (P_{displayed} \times P_{width})}{H_{total}}$$

Where, for PAL video and 640-pixel resolutions:

1. The nominal start of active video is:

   $AV_{start} = 10.5\ \mu s$

   from Figure A–3.

2. The total number of pixels corresponding to the width of active video is:

   $$P_{active} = \frac{51.95\ \mu s}{64.0\ \mu s} \times 912\ pixels \approx 740\ pixels$$

   from Figure A–3 and the *de facto* standard (see assumption 2 in Section A.3.1).

3. The total number of displayed pixels is:

   $P_{displayed} = 640\ pixels$

   from the *de facto* standard (see assumption 2 in Section A.3.1).

4. The total width of the video signal is

   $H_{total} = 64.0\ \mu s$

   from Figure A–3.

5. The width of one pixel is

   $$P_{width} = \frac{64.0 \mu s}{912} = 0.07018\ \mu s$$

Solving equation 5 for the starting position of 640-pixel graphics yields:

$$GH_{start} = \frac{10.5 + \frac{(740 - 640) \times 0.07018}{2}}{64.0} = 0.2189\ H_{total}$$

Solving equation 6 for the ending position of 640-pixel graphics yields:

$$GH_{end} = \frac{10.5 + \frac{(740 - 640) \times 0.07018}{2} + (640 \times 0.07018)}{64.0} = 0.9207\ H_{total}$$

For PAL video these values equate to left and right border widths of 3.509 µs and a start of active graphics at approximately 14.0 µs after the start of horizontal sync. The latter value can be reliably verified with an accurate oscilloscope.

Position of VGA graphics emulating CGA and EGA modes

True VGA graphics map to the edges of active video and require no calculations. However, the starting and ending positions of VGA graphics emulating CGA and EGA graphics must be calculated. To determine the correct position of such graphics over video as a fraction of a horizontal, 15.625-kHz, PAL, video signal given the timing shown in Figure A–3, use the following equations and assumptions for 640-pixel graphics. Note that the resulting positions hold for 320-pixel graphics.

The general equation for the starting position of VGA emulating CGA and EGA graphics centered in active video as a proportion of active H using the nominal start of video as a reference can be expressed as:

$$(7)\quad GH_{start} = \frac{\frac{(P_{active} - P_{displayed}) \times P_{width}}{2}}{H_{active}}$$

Similarly, the general equation for determining the ending position of VGA graphics emulating CGA and EGA graphics as a proportion of active video can be expressed as:

$$(8)\quad GH_{end} = \frac{\frac{(P_{active} - P_{displayed}) \times P_{width}}{2} + (P_{displayed} \times P_{width})}{H_{active}}$$

These equations are identical to equations 5 and 6 in the previous section except that AV_{start} is now equal to zero and therefore dropped from the equations and that H_{total} has been changed to H_{active} where:

H_{active} = 51.95 µs

from Figure A–3.

Solving equation 7 for the starting position of 640-pixel graphics yields:

$$GH_{start} = \frac{\frac{(740 - 640) \times 0.07018}{2}}{51.95} = 0.0675\ H_{active}$$

Solving equation 8 for the ending position of 640-pixel graphics yields:

$$GH_{end} = \frac{\frac{(740 - 640) \times 0.07018}{2} + (640 \times 0.07018)}{51.95} = 0.9321\ H_{active}$$

A.4 Vertical positions

This section explains how to determine the start and end of active graphics relative to vertical video timing. The vertical position of graphics can be expressed both in lines and as a proportion of vertical timing, which is abbreviated V. Using proportions simplifies determining positions for scan-altered systems.

A.4.1 General assumptions

The following general assumptions are used in determining the vertical positions of active graphics relative to NTSC and PAL video.

1. The optimal position for active graphics is centered vertically in the active video.

   Basis: Nominal common practice. However, note that variations in graphics positioning due to monitor centering adjustments cannot be accounted for in the recommendations in this appendix.

2. Vertical resolution is expressed relative to fields, not frames. VGA 480-line mode converts to 240 lines for single-field for computations.

   Basis: Observation.

A.4.2 NTSC

Figure A–4 shows the timing for 15-kHz NTSC video including the position of 200-line graphics. The timing values in the figure are either taken directly from or derived from the accepted standard for NTSC video. The calculations in this section are based on the values shown in the figure.

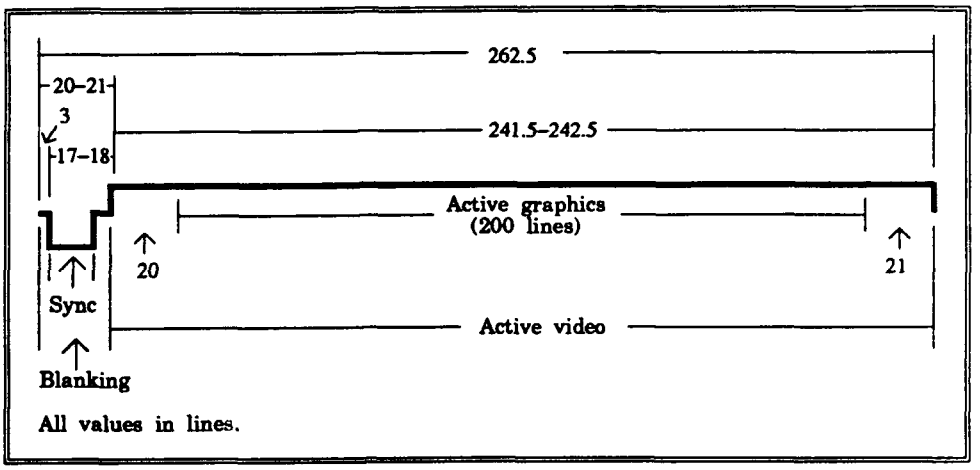


Figure A–4. NTSC vertical timing with 200-line overlayed graphics

Position of graphics in lines relative to vertical sync

To determine the correct position of graphics over video as the number of lines relative to the start of vertical sync for a 15.734-kHz, NTSC, video signal given the timing shown in Figure A–4, use the following equations and assumptions. Note that the calculations can easily be modified for different numbers of lines.

Note: The NTSC standard specifies a vertical blanking interval of 21 lines with error limits of +0 and -1 lines and a total vertical field of 262.5 lines. The calculations below assume a blanking interval of 21 lines, an active video height of 241.5 lines, and a nominal start of active video at 18 lines from the start of vertical sync.

The general equation for the starting position of graphics centered in active video as the number of lines relative to the start of vertical sync can be expressed as:

$$(9)\quad GV_{start} = AV_{start} + \frac{(V_{active} - G_{active})}{2}$$

Similarly, the general equation for the ending position of graphics as the number of lines relative to the start of vertical sync can be expressed as:

$$(10)\quad GV_{end} = AV_{start} + \frac{(V_{active} - G_{active})}{2} + G_{active}$$

Where GV stands for "graphics vertical," and for NTSC video:

1. The nominal start of active video is:

   $AV_{start} = 18\ lines$

   from Figure A–4.

2. The number of active video lines is:

   $V_{active} = 241.5\ lines$

   from Figure A–4.

3. The number of active graphics lines is either:

   $G_{active} = 200\ lines$

   for 640 × 200 and 320 × 200 graphics, or:

   $G_{active} = 240\ lines$

   for 640 × 480 graphics (see assumption 2 in Section A.4.1.)

Starting and ending positions for 200-line graphics

Solving equation 9 for the start of 200-line graphics yields:

$$GV_{start} = 18 + \frac{241.5 - 200}{2} \approx 39\ lines$$

Solving equation 10 for the end of 200-line graphics yields

$$GV_{end} = 18 + \frac{241.5 - 200}{2} + 200 \approx 239\ lines$$

Starting and ending positions for 240-line (640 × 480) graphics

Solving equation 9 for the start of 240-line graphics yields:

$$GV_{start} = 18 + \frac{241.5 - 240}{2} = 18.75\ lines$$

Solving equation 10 for the end of 240-line graphics yields

$$GV_{end} = 18 + \frac{241.5 - 240}{2} + 240 = 258.75\ lines$$

Given the derived values above, VGA 240-line modes actually leave borders of 1 line and 0.5 lines. To avoid screen disturbance, hardware implementers may want to blank these borders. Although this is not a compliance requirement, it is recommended.

Position of graphics as a proportion of total video.

To calculate the position of graphics as a proportion of total vertical timing, simply change equations 9 and 10 to yield:

$$(11)\quad GV_{start} = \frac{AV_{start} + \frac{(V_{active} - G_{active})}{2}}{V_{total}}$$

$$(12)\quad GV_{end} = \frac{AV_{start} + \frac{(V_{active} - G_{active})}{2} + G_{active}}{V_{total}}$$

All terms are defined in the previous section except V_{total}, which for NTSC video is:

$$V_{total} = 262.5\ lines$$

from Figure A–4.

Starting and ending positions for 200-line graphics

Borrowing from the previous section, the starting and ending positions for 200-line graphics as proportions of total V are simply:

$$GV_{start} = \frac{39}{262.5} = 0.1486\ V_{total}$$

$$GV_{end} = \frac{239}{262.5} = 0.9105\ V_{total}$$

Starting and ending positions for 240-line (640 × 480) graphics

Borrowing from the previous section, the starting and ending positions for 240-line graphics as proportions of total V are simply:

$$GV_{start} = \frac{18.75}{262.5} = 0.0714\ V_{total}$$

$$GV_{end} = \frac{258.75}{262.5} = 0.9857\ V_{total}$$

Position of graphics as a proportion of active video

To calculate the position of graphics as a proportion of active vertical timing using the nominal start of video as a reference, simply change equations 11 and 12 to yield:

$$(13)\quad GV_{start} = \frac{\frac{(V_{active} - G_{active})}{2}}{V_{active}}$$

$$(14)\quad GV_{end} = \frac{\frac{(V_{active} - G_{active})}{2} + G_{active}}{V_{active}}$$

All terms are defined in previous sections except V_{active}, which for NTSC video is:

$$V_{active} = 241.5\ lines$$

from Figure A–4.

Starting and ending positions for 200-line graphics

Borrowing from previous sections, the starting and ending positions for 200-line graphics as proportions of active V are simply:

$$GV_{start} = \frac{\frac{(241.5 - 200)}{2}}{241.5} = 0.0859\ V_{active}$$

$$GV_{end} = \frac{\frac{(241.5 - 200)}{2} + 200}{241.5} = 0.9141\ V_{active}$$

Starting and ending positions for 240-line (640 × 480) graphics

Borrowing from previous sections, the starting and ending positions for 240-line graphics as proportions of active V are simply:

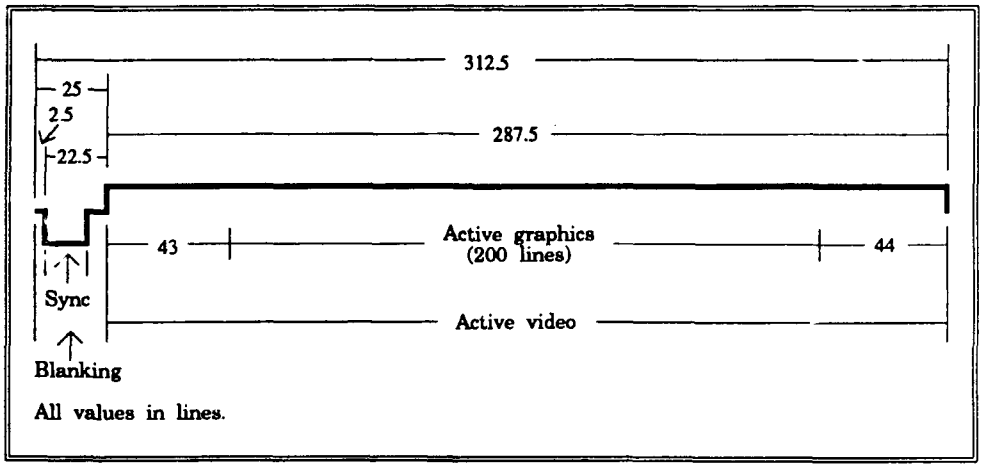
$$GV_{start} = \frac{\frac{(241.5 - 240)}{2}}{241.5} = 0.0031\ V_{active}$$

$$GV_{end} = \frac{\frac{(241.5 - 240)}{2} + 240}{241.5} = 0.9969\ V_{active}$$

A.4.3 PAL

Figure A–5 shows the timing for 15-kHz PAL video including the position of 200-line graphics. The timing values in the figure are either taken directly from or derived from the accepted standard for PAL video. The calculations in this section are based on the values shown in the figure.

Figure A–5. PAL vertical timing with 200-line overlayed graphics



The general equations used to calculate graphics positions for PAL are identical to those for NTSC. However, the values used for the equation variables differ because of differences in vertical timing. For convenience, all equations and variable values are repeated in the following section.

Position of graphics in lines relative to vertical sync

To determine the correct position of graphics over video as the number of lines relative to vertical sync for a 15.625-kHz, PAL, video signal given the timing shown in Figure A–5, use the following equations and assumptions. Note that the calculations can easily be modified for different numbers of graphics lines.

The general equation for the starting position of graphics centered in active video as the number of lines relative to the start of vertical sync can be expressed as:

$$(15)\quad GV_{start} = AV_{start} + \frac{(V_{active} - G_{active})}{2}$$

Similarly, the general equation for the ending position of graphics as the number of lines relative to the start of vertical sync can be expressed as:

$$(16)\quad GV_{end} = AV_{start} + \frac{(V_{active} - G_{active})}{2} + G_{active}$$

Where GV stands for "graphics vertical," and for PAL video:

1. The nominal start of active video is:

   $AV_{start} = 22.5\ lines$

   from Figure A–5.

2. The number of active video lines is:

   $V_{active} = 287.5\ lines$

   from Figure A–5.

3. The number of active graphics lines is either:

   $G_{active} = 200\ lines$

   for 640 × 200 and 320 × 200 graphics, or:

   $G_{active} = 240\ lines$

   for 640 × 480 graphics and various special PAL modes (see assumption 2 in Section A.4.1.)

Starting and ending positions for 200-line graphics

Solving equation 15 for the start of 200-line graphics yields:

$$GV_{start} = 22.5 + \frac{287.5 - 200}{2} \approx 66\ lines$$

Solving equation 16 for the end of 200-line graphics yields

$$GV_{end} = 22.5 + \frac{287.5 - 200}{2} + 200 \approx 266\ lines$$

Starting and ending positions for 240-line graphics

Solving equation 15 for the start of 240-line graphics yields:

$$GV_{start} = 22.5 + \frac{287.5 - 240}{2} \approx 46\ lines$$

Solving equation 16 for the end of 240-line graphics yields

$$GV_{end} = 22.5 + \frac{287.5 - 240}{2} + 240 \approx 286\ lines$$

Position of graphics as a proportion of total video.

To calculate the position of graphics as a proportion of total vertical timing, simply change equations 15 and 16 to yield:

$$(17)\quad GV_{start} = \frac{AV_{start} + \frac{(V_{active} - G_{active})}{2}}{V_{total}}$$

All terms are defined in previous sections except *Vactive*, which for PAL video is:

$$V_{active} = 287.5\ lines$$

from Figure A–5.

Starting and ending positions for 200-line graphics

Borrowing from previous sections, the starting and ending positions for 240-line graphics as proportions of active V are simply:

$$GV_{start} = \frac{\frac{(287.5 - 200)}{2}}{287.5} = 0.1522\ V_{active}$$

$$GV_{end} = \frac{\frac{(287.5 - 200)}{2} + 200}{287.5} = 0.8478\ V_{active}$$

Starting and ending positions for 240-line graphics

Borrowing from previous sections, the starting and ending positions for 240-line graphics as proportions of active V are simply:

$$GV_{start} = \frac{\frac{(287.5 - 240)}{2}}{287.5} = 0.0826\ V_{active}$$

$$GV_{end} = \frac{\frac{(287.5 - 240)}{2} + 240}{287.5} = 0.9174\ V_{active}$$

B IBM PC and compatible graphics modes

Table B–1 lists standard graphics modes returned by BIOS interrupt 10H, service 0FH for IBM and compatible personal computers. Compliant systems need not support all listed modes and may support but **not require** unlisted, nonstandard modes. However, if a system claims support for a listed mode, the mode **must** be supported as listed. Supporting a standard mode in a non-standard manner may make a system noncompliant.

Note that modes 0–3 are overlay modes for all adapter types. Therefore, they are restricted to 200 lines in NTSC and PAL video modes regardless of how many lines the adapter would normally use.

Table B–1. IBM-compatible graphics modes

Mode[1] (decimal)	Type	Resolution	Colors	Overlay mode	Adapter[2]
0, 1	Text	40 x 25	16	Yes	CGA, EGA, MCGA, VGA
2, 3	Text	80 x 25	16	Yes	CGA, EGA, MCGA, VGA
4, 5	Graphics	320 x 200	4	Yes	CGA, EGA, MCGA, VGA
6	Graphics	640 x 200	2	Yes	CGA, EGA, MCGA, VGA
7	Text	80 x 25	Mono	No	EGA, VGA
13	Graphics	320 x 200	16	Yes	EGA, VGA
14	Graphics	640 x 200	16	Yes	EGA, VGA
15	Graphics	640 x 350	Mono	No	EGA, VGA
16	Graphics	640 x 350	16	No	EGA, VGA
17	Graphics	640 x 480	2	Yes	MCGA, VGA
18	Graphics	640 x 480	16	Yes	VGA
19	Graphics	320 x 200	256	Yes	MCGA, VGA

[1]Does not include modes exclusive to the IBM PCjr and internal BIOS modes.
[2]CGA = Color Graphics Adapter, EGA = Enhanced Graphics Adapter, MCGA = Multicolor Graphics Array, VGA = Video Graphics Array

Note: An application written for a compliant system based on one adapter may not be portable to a compliant system based on a different adapter. For example, a compliant application that uses mode 19 will not be portable to a compliant system that is limited to EGA modes.

Any system that requires applications to use a nonstandard graphics mode is noncompliant. Any application that uses a nonstandard mode is noncompliant.

C Application programming examples

This subsection gives several brief programming examples that use the ASCII and binary interfaces. The examples are intended only to furnish a starting point for programmers. They are not intended to be overly sophisticated or complete. Therein lies the makings of another document.

C.1 Using the ASCII interface

Even programming systems with minimal facilities for interfacing to other languages can use an installable device driver. The two short programs below use the Microsoft *GWBASIC interpreter*.

> For clarity and brevity, these programs do not determine which service groups are present or check for errors after issuing commands. However, well-behaved applications should do both.

```
10 OPEN "O",#1,"ivdev"
20 PRINT #1, "syInit"
30 PRINT #1, "vmInit"
40 PRINT #1, "vdInit"
50 PRINT #1, "xyInit"
50 PRINT #1,"vdPlay start=1000,stop=2000,wait"
60 CLOSE #1
70 OPEN "I",#1,"ivdev"
80 INPUT #1,R$
90 CLOSE #1
100 IF R$="OK" THEN PRINT "Playing" ELSE PRINT
    "PROBLEMS! ";R$
110  OPEN "O",#1,"ivdev"
120 PRINT #1, "syStop"
130 CLOSE #1
140 END
```

```
10 OPEN "O",#1,"ivdev"
20 PRINT #1, "syInit"
30 PRINT #1, "vmInit"
40 PRINT #1, "vdInit"
50 PRINT #1, "xyInit"
60 PRINT #1,"vmGetPalette color=5,r,g,b"
70 CLOSE #1
80 OPEN "I",#1,"ivdev"
90 INPUT #1,R$
100 CLOSE #1
110 REM The next section of code would parse R$, which is
120 REM in the form "<r value>,<g value>,<b value>"
...
200 REM Now shut it down
210 OPEN "O",#1,"ivdev"
220 PRINT #1, "syStop"
230 CLOSE #1
240 END
```

C.2 Using software interrupt calls

Programming systems with library facilities for software interrupts can use direct software interrupt calls for issuing commands. The following example uses Microsoft C 5.1. It is a code fragment, not a complete program, and, as such, is not compilable.

```
/*
 * This example gets the values for a logical color.
 * Obviously, a well-structured program would hide the
 * interrupt call in a separate function.
 * The example omits typical start-up and shut-down code
 */

#include <stdio.h>
#include <dos.h>

#define VMGETPALETTE 2049
#define COLORPARM    9
#define RED          38
#define GREEN        25
#define BLUE         4

struct ivparm
{
  long parm_id;
  long parm_val;
} parms [20], far *p;
```

```
union REGS cpuregs;
struct SREGS segregs;

int iv_int = 0x60     /* software interrupt, normally */
                      /* read from environment        */

/*
 * The following code fragment would be included in
 * function blocks
 */

  /* initialize far pointer */

  p = parms;

  /* Set up parameter block */

  parms[0].parm_id  = COLORPARM;
  parms[0].parm_val = 5;
  parms[1].parm_id  = RED;
  parms[2].parm_id  = GREEN;
  parms[3].parm_id  = BLUE;

  /*
   * Set up CPU registers and call software interrupt.
   * cpuregs and segregs are structures for manipulating
   * CPU registers. FP_OFF and FP_SEG are macros that
   * find the absolute address of a variable.
   */

  cpuregs.x.ax = VMGETPALETTE;
  cpuregs.x.bx = 4;              /* number of parameters */
  cpuregs.x.di = FP_OFF(p);
  segregs.es   = FP_SEG(p);

  /*
   * int86x() is an MSC library function that calls
   * a software interrupt.
   */

  int86x(iv_int, &cpuregs, &cpuregs, &segregs);

  /* Check for errors */

  if (cpuregs.x.ax != 0)
    {
    printf("Error code: %d\n", (int) cpuregs.x.ax);
    exit(1);
    }

  /* Print the color values */

  printf("Color 5 Red,Green,Blue %d,%d,%d\n",
    (int) parms[1].parm_val, (int) parms[2].parm_val,
    (int) parms[3].parm_val);
```

C.3 Library calls with parameter numbers

Vendors may furnish libraries for specific languages that use parameter numbers of the binary interface stored in a data structure appropriate to the language. Several languages support functions that accept variable numbers of parameters. The following example uses Microsoft C 5.1 to show how to use variable numbers of parameters to set up a parameter block. It omits the code that would then execute the function.

```
#include <stdio.h>
#include <stdarg.h>     /* for ANSI compatibility */

/*
 * This function might be part of a support library.
 * va_start() and va_arg() are macros for accessing
 * variable-length argument lists.
 * (See MSC 5.1 manuals for details.)
 */

iv_vdplay(long parm1, ...)
{
  va_list argp;
  struct ivparm
  {
    long parm_id;
    long parm_val;
  } parms [20];
  int i;

  va_start(argp, parm1);

  /* Set up parameter block from variable arg list */

  for(i = 0; parms[i].parm_id != NULL && i < 20; i++)
    {
    parms[i].parm_id = va_arg(argp, long);
    parms[i].parm_val = va_arg(argp, long);
    }

  /* Now insert rest of code to execute command */]

  ...
}
```

C.4 Analyzing bit fields

It is simple to analyze bit fields with any language that supports bit-wise "and". The following example uses the Microsoft GWBASIC interpreter.

```
100 REM Start by initializing the system
110 OPEN "O",#1,"ivdev"
120 PRINT #1,"syInit"
130 CLOSE #1
140 OPEN "I",#1,"ivdev"
150 INPUT #1,R$
160 CLOSE #1
170 IF R$ <> "OK" THEN PRINT "Cannot initialize system"
    :GOTO 300
180 REM Now request the support information
190 OPEN "O",#1,"ivdev"
200 PRINT #1,"syGetState"
210 CLOSE #1
220 OPEN "I",#1,"ivdev"
230 INPUT #1,R$
240 CLOSE #1
250 REM R$ now contains the decimal string which
260 represents the support bit field
270 R=VAL(R$)
280 REM Do the "AND" to check whether xy is supported
290 IF R AND 8 THEN PRINT "XY input is supported"
    ELSE PRINT "XY input is not supported"
300 OPEN "O",#1,"ivdev"
310 PRINT #1,"syStop"
320 CLOSE #1
330 END
```

D Error handling

When an application issues a command, VDI Management may be unable to carry out the requested action or return the requested information. This causes an error. This appendix describes the error codes that VDI Management can return to an application.

D.1 General information

The ASCII interface returns errors as response strings consisting of the word "ERROR" followed by a space and the error number. For example, "ERROR 49" signals that a command included insufficient parameters. The binary interface returns error numbers in the microprocessor's AX register on return from the software interrupt (AX=0 indicates success).

Some VDI Management implementations may not use all the error codes. For example, a system that does not use the MS–DOS filing system probably would not use the filing-system error codes.[1] However, implementors should try to be complete and should not omit error codes simply for convenience.

> VDI Management implementations may supply textual error messages. (See **syErrorMsg** in Section 6.) Although this is not a compliance requirement, if an implementation does support textual error messages, it must use the summary messages given in this appendix. Although this appendix presents summary messages in mixed case for legibility, VDI Management returns summary messages (and all other return strings) in all capital letters.

VDI Management should try to recover before returning an error response to the application. For example, if a communications error occurs, VDI Management should return an error only after repeated retries have failed.

1 Filing-system error codes are included primarily for use by future digital audio commands.

Note: VDI Management cannot handle the error of a user forgetting to install VDI Management or the correct interface used by an application. Applications should guard against this by confirming that VDI Management and the proper interface are installed (see Sections 3.2.2 and 3.3.2).

D.2 Error listings

The following subsections list error numbers in numerical order with summary messages and brief explanations. Related errors are grouped for convenience and do not necessarily imply a corresponding programming structure in VDI Management implementations. However, implementations should use the error numbers as they are defined.

D.2.1 Command problems

1 Service group not installed

The VDI implementation supports the service group that contains the command, but the service group is not installed. For example, an application issued an xy command on a system that is not configured for XY-input devices.

2 Unknown command

The command does not exist.

Compliant VDI implementations cannot return this error in response to any core command for a supported service group.

3 System not initialized

The command was issued before the application issued **syInit**, or **syStop** was followed by a command other than **syInit**.

15 General command error

A command error occurred that is not listed above or about which no information is available.

D Error handling

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2 Unknown command

The command does not exist.

Compliant VDI implementations cannot return this error in response to any core command for a supported service group.

3 System not initialized

The command was issued before the application issued **syInit**, or **syStop** was followed by a command other than **syInit**.

15 General command error

A command error occurred that is not listed above or about which no information is available.

D.2.2 ASCII interface problems

16 Bad command syntax

The parser encountered a fatal syntax error that could not be further diagnosed. For example, a command string contained a control code.

> Error 16 should not be used in place of parameter-problems errors (see Section D.2.4).

17 Command too long

The command was longer than 255 characters and will be ignored in its entirety. (The terminal carriage return counts but redundant delimiters do not.)

18 Response too long

The response to an information request including the terminal CR/LF would be longer than 255 characters. VDI Management does not return partially filled information requests. For example, the application used an **xx**Get-**State** command to request too much information.

19 Device driver read before write

The application tried to read a response from the device driver before it had written at least one command to it. This is illegal and indicates a problem with the application's initialization code.

This error can occur only immediately after VDI Management has been installed or after a well-behaved application has issued an **syStop** before exiting.

31 General ASCII interface error

An ASCII interface error has occurred that is not listed above or about which no information is available.

D.2.3 Binary interface problems

32 Invalid parameter count

On 80x86-based systems, the BX register contains an invalid or out of range parameter count. For example, the application passed a negative value in BX.

33 Invalid parameter packet address

On 80x86-based systems, the ES:DI register pair contains an invalid address for a parameter packet.

34 Invalid pointer in parameter packet

The parameter packet contains a null or invalid pointer.

47 General binary interface error

A binary interface error occurred that is not listed above or about which no information is available.

D.2.4 Parameter problems

48 Unknown parameter

The command included a parameter label that is not valid for any command.

Compliant VDI implementations cannot return this error in response to any core parameter for a supported service group.

49 Insufficient parameters

The command required: a specific parameter that was missing; at least one parameter from a specific group of parameters and was issued without the parameter; or at least one parameter that could have been any parameter in its list and was issued with no parameters.

50 Parameters cannot be used together

The command included two or more parameters that cannot be used together. For example, a **vdPlay** command included both a **direction** and a **to** parameter.

51 Parameter value invalid or out of range

The command included an incorrect parameter value. For example, a parameter value that must be in the range 0–255 was negative or greater than 255.

This error can result from the combined effects of two or more parameters and from exceeding limits set by another parameter. For example, with the **vmSetPalette** command the sum of the **color** and **length** parameters must be less than or equal to **logcolors** plus one. (**Logcolors** is the maximum

number of available logical colors, which can be retrieved with the **vmGetState** command.)

52 Parameter invalid for this command

The command included a known but invalid parameter. For example, the application issued **syInit** with a **color** parameter.

53 Missing parameter value

The command failed to include a value for a parameter that requires one. The parser reached either the end of the command string or another parameter label when a parameter value was expected.

This is an ASCII interface error only.

54 Parameter used more than once

The command included the same parameter more than once. This is never allowed.

79 General parameter error

A parameter error occurred that is not listed above or about which no information is available.

D.2.5 Hardware problems

80 Initialization error

The system could not initialize an attached device. The application can find out which device by examining the failed command.

81 Device not initialized

The application tried to use either an uninitialized device or an uninitialized service group.

82 Communications timeout

A timeout occurred while VDI Management was communicating with a peripheral device. Either the device did not produce an expected message within a predetermined timeout period, or the computer was unable to send a message to the device because signal control lines were in an appropriate state. For example, this error would result from a cable being unplugged after a device has been initialized.

83 Communications error

An error occurred during communications. For example, repeated parity errors that cannot be cleared during asynchronous serial communications cause this error.

84 Device reports error

A peripheral device sent a message indicating that an error occurred that it cannot clear.

85 Device canceled request

A peripheral device sent a message indicating that it has unilaterally canceled a requested service.

86 Device not ready

A peripheral device sent a message indicating that it cannot be made operational.

87 Action not supported by device

A peripheral device sent a message indicating that it cannot do a requested action. This error indicates either an installation problem or the inappropriate use of the **vdPassThru** command. Compliant systems should not normally generate this error.

88 Unable to return requested information

A hardware device could not generate information requested by a command. For example, a CLV videodisc could not report a frame number.

111 General hardware error

A hardware error occurred that is not listed above or about which no information is available.

D.2.6 System resources

Some systems may not be able to return some errors in this group.

112 Insufficient memory

VDI Management could not access enough memory to perform the requested service.

113 Needed hardware interrupt in use

VDI Management requires the use of a specific hardware interrupt that is already in use, or one of a range of interrupts and all are in use.

114 Needed software interrupt in use

VDI Management requires the use of a specific software interrupt that is already in use, or one of a range of interrupts and all are in use.

115 Needed DMA channel not available

VDI Management requires the use of a specific DMA channel that is already in use, or requires the use of any DMA channel and all are in use.

116 Needed timer not available

VDI Management requires the use of a timer resource that is not available.

127 General resources error

VDI Management requires additional system resources that are not listed above or about which no information is available.

D.2.7 Filing system problems

128 Invalid filename

The command used a filename that was invalid for the operating system. (A legal filename that cannot be opened should return error 132.)

129 Invalid path

The command used a path name that was invalid for the operating system.

130 Invalid drive

The command specified a drive that is not recognized by the operating system.

131 Invalid file number

The command used a file number that was not recognized by the operating system.

132 Cannot open or create file

The operating system could not open or create a requested file.

133 Cannot close file

The operating system could not close a requested file.

134 File already open

The command tried to open a file that was already open.

135 File already exists

The command tried to create a file that already exists.

136 File does not exist

The command tried to access a file that does not exist.

137 File access denied

The command was denied access to a requested file. For example, a file with a locked status on a network file server would cause this error.

138 File seek error

The command tried to use a nonexistent piece of a file. For example, a command tried to access byte 9000 of a 5–KB file.

139 Too many open files

The operating system has run out of file handles because too many files are open. Either the application should open fewer files or the user should change the operating system installation to allow more files to be open simultaneously.

140 Disk full

The command tried to write to a full disk. The user should delete some files or change to a different disk before trying to run the application again.

141 Disk read error

A data error occurred while reading the disk.

142 Disk write error

A data error occurred while writing to the disk.

159 General filing-system error

A filing-system error occurred that is not listed above or about which no information is available.

D.2.8 Miscellaneous problems

160 Invalid device number

The command specified an invalid device or source number. This error results from using an invalid number for a device or source parameter or from trying to change the default device or source to an invalid number.

161 Buffer overflow

An internal VDI Management buffer overflowed. This indicates an internal VDI Management failure and should be brought to the attention of the system vendor.

162 Internal calculation error

An error such as divide by zero occurred during a numeric calculation within VDI Management. This indicates an internal VDI Management failure and should be brought to the attention of the system vendor.

163 Copy protection error

A copy protected version of VDI Management has declined to run because its protection scheme has been violated. Legitimate users should discuss this problem with the system vendor.

173 General internal error

An internal VDI Management error occurred that is not listed above or about which no information is available. This indicates an internal VDI Management failure and should be brought to the attention of the system vendor.

174 General operating system error

The operating system reported an error unrelated to the filing system and not specific to any particular aspect of VDI Management. (VDI Management should try to recover from this error before returning it to the application.)

175 General error

An error occurred that is not listed elsewhere and about which no information at all is available.

This error differs from error 111 (General hardware error) in that error 111 guarantees that a hardware error has occurred while this error can be caused by any unknown failure including unknown hardware, VDI Management, and application failures.

VDI implementors should not use this error number before carefully considering whether a more informative error code could be used. This is an error of last resort.

D.2.9 System group problems

176 Queue full

The application tried to queue more than 10 commands. This indicates an application problem such as failing to turn **syQueue** off at the appropriate time.

177 Command cannot be queued

The application tried to queue a command that cannot be queued. This indicates an application problem such as failing to turn **syQueue** off at the appropriate time.

191 General system error

A problem occurred within the system group that is not listed above or about which no further information is available.

D.2.10 Visual-management problems

192 Synchronization error

The video signal could not be genlocked to the computer's graphics because the signal has an inappropriate scan rate. Overlay is not possible.

193 Graphics mode problem

The system could not do a requested action because the graphics mode does not support it. For example, the application tried to turn on transparency in a graphics mode that does not support overlays.

194 Unsupported graphics mode

The system could not switch to a requested graphics mode or emulation state because the hardware does not support the mode. For example, issuing **vmSetGraphics emulation=0**, which requires a VGA adapter, on a CGA or EGA system, or issuing **vmSetGraphics mode=14**, which requires an EGA

graphics adapter, on a CGA system would cause this error. (See Appendix A for more information on VGA native and emulation modes.)

207 General visual-management error

A problem occurred with the visual management functions that is not listed above or about which no further information is available.

D.2.11 Videodisc problems

208 Action not supported by disc

The command requested an action that is not supported by the videodisc. For example the application tried to do a frame search on a CLV videodisc or a chapter search on a videodisc that without chapter stops.

209 Disc not spun up

The application issued a command such as **vdPlay** that requires the videodisc to be spun up when it has not been spun up.

210 Disc not spun down

The application issued a command such as **vdSet door=1** that requires the videodisc to be spun down when it has not been spun down.

211 Door open

The application issued a videodisc motion command other than **vdSet door=0** with the player door open. Typically, this is a user error that can be corrected without exiting the application.

212 No disc in tray

The application issued a videodisc motion command other than **vdSet door=1** with the player door closed but without a videodisc in the tray. Typically, this is a user error that can be corrected without exiting the application.

213 Bad disc section

It was impossible to seek to the required frame because of a physical problem with the videodisc.

214 Fell off disc

An attempt was made to play backward past the beginning or forward past the end of the videodisc. This normally indicates improper use of a videodisc motion command.

215 Invalid frame number

The command specified a frame that is not present on the videodisc.

216 Invalid chapter number

The command specified a chapter that is not present on the videodisc.

217 Invalid time code

The command specified a time code that is not present on the videodisc.

239 General videodisc player error

A videodisc error occurred that is not listed above or about which no information is available.

D.2.12 XY-input device problems

240 Device not calibrated

A required, implementation-specific, calibration process has not been done. The user should verify that the XY-input device is installed correctly.

241 Invalid coordinate

A coordinate was specified that is outside the acceptable range. This normally indicates an application problem.

242 Cursor problem

A problem with the graphics device caused a cursor display problem. This indicates that the application requires a facility that VDI Management does not furnish.

255 General XY-input error

An XY-input error occurred that is not listed above or about which no information is available.

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